United States
Department of
Agriculture

Forest Service

Forest Health
Protection

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OPTIMUM SPRAY CALCULATION

FHTET 96-36
December 1996

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Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides where there is danger of drift when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment, if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

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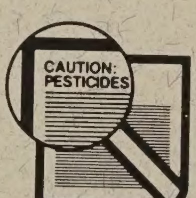

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Optimum Spray Calculation

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Contract No. 26-3651
(July 1, 1976)

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Abstract

A computer program has been developed to expedite the calculations outlined in the report entitled, "An Approximate Method for Selecting Optimum Drop Sizes" by R. Ekblad. The derivation of the equations upon which the program is based, together with the program listing and typical results, are presented. A second program entitled, "Minimum Drop Size Calculation", has been written to facilitate the calculation of the minimum lethal spray drop size. Comments on the relevant literature are also made.

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Introduction

The spraying of forest insects with an insecticide dispersed from an airplane or a helicopter is a very common method for controlling insect damage to tree stands. Several parameters are available for controlling the effectiveness of the spray. Some of these are: the distribution of the drop sizes, the wind velocity, the air temperature, the humidity, etc. These parameters are not independent in their action and the variation in the spray effectiveness due to a variation in these parameters is not readily predicted. In an attempt to analyze this problem, R. Ekblad has developed a method of analysis which is described in his paper entitled, "An Approximate Method for Selecting Optimum Drop Size", (ref. 1). It is assumed that the reader is familiar with the contents of this report and consequently it will not be discussed in complete detail here. It is the purpose of this report to describe the development of a computer program based upon Ekblad's analysis.

The objective of Ekblad's report is to describe a method for selecting the optimal spray drop diameter distribution given a characteristic target size, the physical characteristics of the air; such as the density, viscosity and velocity, together with the density and toxicity of the spray. The optimal drop size depends upon the effectiveness of the spray which is estimated in terms of a base spray intensity. The base spray intensity is the number of drops of a given diameter appearing on a surface of one square centimeter due to a total spray volume which is usually measured in liters per hectare. In this work, total spray volume will be measured in gallons per acre.

A measure of the effectiveness of a spray is the probability of kill which is defined to be the total number of drops of a specified base spray intensity impacting a given target resulting in a "kill" of that target. Thus, by calculating the probability of kill for sprays with different distributions of drop sizes and the same base spray intensity, that is the same total spray volume, it is possible to determine the optimum drop size for the specified base spray intensity. A target is said to be killed when it has received a minimum lethal dose of an insecticide. The minimum lethal dose is described in terms of a percent kill and is commonly denoted by LD_x where x is the percent killed. Thus, LD_{90} denotes a 90% kill. The lethal dose depends upon the toxicity and concentration of the insecticide. It is assumed that if a spray drop is of lethal size and touches a target, the target has been killed. The optimal drop size is determined by maximizing the total probability of kill as a function of drop size distribution.

The work that follows presents the analysis necessary to derive equations upon which the computer programs are based. Also included are the computer programs and their documentation. Two programs have been written. The first is entitled, "Optimum Spray Drop Calculation" and the second is entitled, "Minimum Drop Size Calculation".

The programs have been designed for ease of use by an analyst accessing the computer from a remote terminal in the time share mode. This programming style has been chosen because the program is to be

an investigative tool. In addition, such a design makes the program easier to use in a field station since only a simple terminal is required as opposed to the necessity of having a remote job entry terminal if the batch mode of operation is used.

Several computer runs have been included to illustrate the program results. The selection of parameters used in the runs was made in accord with the contract monitor.

In the following discussion frequent reference will be made to program line numbers. This should enable an easier conclusion of the discussion with the program which is given in figures 9a-9j. Figures 5, 6a-6c, 7a, 7b and 8 are flowcharts depicting the organization of the program.

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Technical Approach

In order to determine the probability of kill for a spray containing a distribution of particle sizes, the distribution is characterized by a set of diameter classes and the number of particles of the spray in each class. The probability of kill is calculated for each diameter class for the same total spray intensity assuming that the spray consists only of drops of a constant diameter. The probability of kill for a distribution of drops is then calculated by taking a weighted sum of these probabilities of kill. The weights are the fraction of the total spray mass in each size category. Such a weighting is equivalent to weighting by fraction of volume of spray in each size class.

The determination of the probability of kill for a specified diameter class requires the determination of the impact efficiency of a collection of particles all of which are of a constant diameter. The work of Brun et al (ref. 2) gives the impact efficiency of a collection of particles of equal size impinging upon a right circular cylinder. It is assumed the particles are distributed homogeneously throughout the air stream which is moving in a direction perpendicular to the axis of the cylinder. The impact efficiency is the reciprocal of the ratio of the number of particles contained in the cross-sectional area swept out by the cylinder to the number of particles in the section which actually impinges upon the cylinder. Brun et al give the impact efficiency, E, as a function of two dimensionless parameters κ and ϕ, i.e. $E=E(K, \phi)$. K and ϕ are defined as:

$$\kappa = 3.50824 \times 10^{-12} \frac{\rho_w a^2 U}{\mu L}$$

and

$$\phi = 26.40 \quad \frac{\rho_a^{\,2} \; L \; U}{\mu \rho_w}$$

where

ρ_a, ρ_w = density of air and water respectively in lbs/ft^3

a = radius of drop in microns

U = velocity of air in miles per hour

L = target radius in feet

μ = air viscosity in lbs/(ft.sec.).

Their results are presented in table 1 and appear in the program in lines 1310 to 1360 where X and Y denote κ and ϕ respectively.

It is assumed that the target is a larva or pine needle whose shape may be approximated by a right circular cylinder of given diameter. From data on the toxicity of insecticides to forest insects, (ref. 3 and ref. 4), the desired dose may be obtained. The dose, or dosage, is the intensity of the application of the insecticide and is the ratio of the amount of applied pure insecticide to the body weight of the insect. The dose is usually expressed in units of micrograms of pure insecticide per gram of insect body weight or in units of ounces of pure insecticide applied per acre. The ratio of the volume of a lethal drop to the volume of the drop used in the impact efficiency calculation gives the kill ratio of

the drop. The distribution of drops in the spray is characterized by the number of drops belonging to each diameter class of the spray. A diameter class is an interval resulting from the partitioning of the total range of drop sizes in the spray. The product of the number of drops of a given diameter, the corresponding impact efficiency and the kill ratio gives the probability of kill for the number of drops of the given diameter in the diameter class.

The sum of these probabilities for all the drop size classes in the spray is the probability of kill for the entire drop distribution. These calculations are accomplished in lines 4635 to 4680 of the program.

This method of estimating the total probability of kill omits many factors which are known to affect the determination of a quantitative estimation of the effectiveness of a spray. Some of the effects which are not accounted for in the analysis are the effect of evaporation, of coagulation and of filtering due to the canopy or foliage of the tree. The role of turbulence or local air motion has also been ignored. The inclusion of these effects is not simple because both the experimental techniques and the theoretical analysis are formidable. However, it is possible on the basis of what seems reasonable assumptions, to derive approximations for these effects. Future work will concentrate on developing such approximations and including them in the program.

There are two common experimental techniques for the determination of lethal doses. The first technique, called the topical application method, consists of individual carefully-measured applications of the insecticide followed by a determination of the percent kill resulting from the application. The technique gives the dose necessary to kill a specified percentage of the larva. The specified percentage of killed larva is denoted by LD_x and the required dose is expressed in units of micrograms of pure insecticide per gram of body weight of the insect. For each LD_x, there is a required dose.

The other technique, called the spray application method, consists in depositing the insecticide on the insect larva with the aid of a sprayer. The drop and density distribution from the spray is accurately controlled and the subsequent insect mortality determined. The required dose corresponding to a given LD_x is given in terms of ounces of pure insecticide per acre corresponding to an applied volume of spray which is specified in gallons per acre.

For both of these empirically determined dose statistics it is possible to derive a minimum drop diameter due to a specified spray concentration corresponding to a desired LD_x. This derivation is given in another section of this report.

<u>Impact Efficiency Subroutine</u>

This subroutine is the heart of the program and is essentially a table look-up to determine the impact efficiency, E. E is a function of the two dimensionless variables, κ and ϕ .

Since E is a function of two variables and is known only at specified points in the (κ, ϕ) space, it is necessary to use double interpolation (ref. 6) to estimate E whenever the point (κ, ϕ) does not correspond to a grid point. The interpolation technique employed in this work is linear in both variables and uses a logarithmic interpolation scheme to estimate a pair of weighting parameters, A_1 and B_1. These parameters are then used to evaluate E from the expression

$$E = (1-A_1)(1-B_1)E_{i,j}+B_1(1-A_1)E_{i,j+1}+A_1(1-B_1)E_{i+1,j}+A_1B_1E_{i+1,j+1} \cdot \quad (2.1)$$

In equation 2.1, $E_{i,j}$ denotes $E(\kappa_i, \phi_j)$ and i and j are the indices of the point specifying the quadrangle of the interpolation table containing (κ, ϕ). Thus, (i,j) characterizes the quadrangle whose pairs of opposite vertices are given by (i,j) and (i+1,j+1), and (i+1,j) and (i,j+1). The values of i and j are determined in lines 8310-8335. The weighting parameters are given by

$$A_1 = \frac{\ln \chi - \ln \chi_i}{\ln \chi_{i+1} - \ln \chi_i} \tag{2.2}$$

and

$$B_1 = \frac{\ln \phi - \ln(\phi_j + 1)}{\ln \phi_{j+1} - \ln(\phi_j + 1)} \quad . \tag{2.3}$$

Equations (2.2) and (2.3) appear in lines 8410 and 8415 and equation (2.1) is accomplished in lines 8480-8490. The notation $X = \chi$ and $Y = \phi$ has been used. Since ϕ_o is zero, the value 1 is added to ϕ_j in equation 2.3 to insure the avoiding of attempting "to take the logarithm of 0". This procedure results in at most a very small error, since $\phi_{j \neq 0} \geq 100$.

It may be the case that either χ or ϕ, or both χ and ϕ, are outside of the range of the table. In this event special action must be taken. If either χ or ϕ are less than zero, lines 8230 and 8235, in conjunction with lines 8260 and 8270 respectively, cause the program to stop. Similarly, if $\phi > 50{,}000$, lines 8245 and 8290 cause the program to stop. In all three cases the reason for stopping the program is printed out. It can also happen that $\chi > 320$. In this event, the impact efficiency is set equal to one providing the value of ϕ lies in the table range. See lines 8240 and 8277. An examination of the graphical representation of $E(\chi, \phi)$, as given in reference 2, shows that, at most, only a very small error is incurred by setting the impact

efficiency equal to zero for large values of κ . Whenever the above condition obtains, the computer prints out a statement like:

"FOR SIZE CLASS NO. 6 X=466.326 AND X > X(1Ø), THUS E=1."

(See for example, page 16.2 where this statement is printed out 11 times for size classes 6 through 16). The program variable X denotes the dimensionless variable .

For values of (κ, ϕ) in the range of the table, the determination of E for small values of κ and ϕ requires special interpolation formulae. The next paragraph describes these interpolation formulae and the region of the table in which they are used.

Lines 8355 and 8360 set the impact efficiency equal to zero if $\kappa < 0.1$. If $0.1 \leq \kappa \leq 0.25$, lines 8385 and 8470 calculate the impact efficiency from the expression

$$E = 0.178958E_{i,j} \{\exp(\exp[5(\kappa - 0.1)]) - 2.7128\} . \qquad (2.4)$$

This expression was obtained by noting the extreme exponential-like behavior of E with κ whenever $0.1 \leq \kappa \leq 0.25$. If $\kappa > 0.25$ <u>and</u> $\phi < 5$, the variation of the impact efficiency with ϕ is negligible and hence the weighting factor B1 is set equal to zero. The calculation of E for this range of κ and ϕ is given in lines 8440 to 8445 and line 8390 determines whether or not ϕ is in the required range.

The flowchart of the entire subroutine is shown in figures 7a and 7b.

In order that the reader may more easily correlate the previous development with the equations used in the program, the following table of notation is presented.

Mathematical Notation	BASIC Notation
$\varkappa$	X
ϕ	Y
A_1	A1
B_1	B1
i	I
j	J
$E_{i,j}$	E(I,J)

In terms of the BASIC programming notation, equation 2.1 appears as:

```
8480  LET E1 = (1-A1)*(1-B1)*E(I,J) + B1*(1-A1)*E(I,J+1)

8485  LET E2 = A1*(1-B1)*E(I+1,J) + A1*B1*E(I+1,J+1)

8490  LET E = E1 + E2
```

Equations 2.2 and 2.3 are written as:

```
8410  LET Al = (LOG(X) - LOG(X(I)))/(LOG(X(I+1)) - LOG(X(I)))

9415  LET Bl = (LOG(Y) - LOG(Y(J)+1)))/(LOG(Y(J+1)) - LOG(Y(J)+1))
```

and equation 2.4 in the program appears as

```
8470  LET E = .178958*E(I,J)*(EXP(EXP(5*(X-.1))) - 2.7128).
```

Calculation of the Probability of Kill Per Class Using the ASCAS Input Data

The comparison of the effectiveness of different spray distributions requires a determination of the drop distribution in a spray of prescribed intensity. The intensity of the spray is measured in units of liters per hectare or gallons per acre. An actual drop distribution is obtained from an experiment which consists in recording drop stain sizes appearing on sets of cards placed at prescribed locations in the spray area. The reading and the recording of the drop stain sizes is accomplished with the aid of an instrument and the ASCAS computer program converts the recorded data to actual drop size data. This section of the report describes the calculation of the probability of kill due to a spray of specified intensity and an experimentally determined drop stain size distribution furnished by the ASCAS computer program.

The probability of kill for a given spray intensity is the sum of the probabilities of kill due each drop size class. The probability of kill corresponding to a size class is the number of drops in the size class, $(N3)_i$, times the impact efficiency corresponding to that drop size and the appropriate meteorological conditions during the spray. This assumes that every drop impinging upon the target is a lethal drop. If a minimum lethal drop size is required (see line 1385), the probability of kill as obtained from the assumption that all drops are lethal must be

reduced in proportion to the number of drops required to constiture a lethal drop. See lines 4635-4640.

The total number of drops in the size class corresponding to a specified drop stain distribution will be denoted by $(A7)_i$. $(A7)_i$ is determined by calculating the number of drops, $(P7)_i$, in the spray corresponding to the size class, and then weighting this number in accord with the fraction of the drop mass in the i^{th} size class which fraction is obtained from the ASCAS drop stain data. $(P7)_i$ is obtained by dividing the spray intensity by the volume of the average size drop in the drop size class. The diameter of the average drop is obtained from the ASCAS data in the following way.

The ASCAS program gives the number of drops $(N3)_i$ in a given drop diameter class. The class boundaries are denoted by $(S3)_i$ and are measured in microns. Thus, $(N3)_i$ denotes the number of drops in the size class whose inner drop stain diameter is $(S3)_{i-1}+1$ and whose outer drop stain diameter is $(S3)_i$. The size class boundaries are prescribed in terms of drop stain diameters rather than drop diameters since that is the way the boundaries are obtained from the automated reading instrument. The diameter of the average drop stain in the i^{th} size class, $(D3)_i$ is obtained from

$$\frac{\pi}{6}(D3)_i^2 = \left(\frac{\pi}{6}\right)\frac{1}{\{(S3)_i - [(S3)_{i-1}+1]\}}\int_{(S3)_{i-1}+1}^{(S3)_i} D^2\,dD .$$

Hence

$$(D3)_i = \sqrt{\frac{(S3)_i^3 - [(S3)_{i-1}+1]^3}{3\{(S3)_i - [(S3)_{i-1}+1]\}}}$$

where $(D3)_i$ is measured in microns. In these expressions the term $(S3)_{i-1}+1$ is used rather than the term $(S3)_{i-1}$ since the counting mechanism reads in units of microns. Because the lower limit of integration is 0, the expression for $(D3)_1$ appears in the simple form

$$(D3)_i = \frac{\sqrt{3}}{3}(S3)_i \quad .$$

The above calculations are accomplished in lines 3525 to 3550. The conversion of the average drop stain diameter to the average drop diameter, $(R3)_i$, requires the use of the magnification factors appropriate to the particular set of ASCAS data. The conversion equation is

$$(R3)_i = A + BF(D3)_i + CF(D3)_i^2$$

where A, B, C and F are the magnification factors. Line 4545 accomplishes this conversion.

$(N7)_i$ is the number of drops of diameter $(R3)_i$ in an amount of spray covering one square centimeter resulting from a mono-dispersal spray of intensity Q liters per hectare. Thus,

$$(N7)_i = \frac{60}{\pi} \left(\frac{100}{(R3)_i} \right)^3 Q$$

or

$$(N7)_i = \frac{1.90761 \times 10^7}{(R3)_i^3} Q$$

where $(R3)_i$ is measured in microns. If the spray intensity is given as Q gallons per acre, the number of drops per square centimeter due to such a spray intensity, assuming a mono-disperse spray, is

$$(N7)_i = \frac{1.78642 \times 10^8}{(R3)_i^3} Q.$$

This expression is derived from the preceding expression by noting that one gallon per acre is equivalent to 9.3536969 liters per hectare. It is this latter expression which is used in the computer program because it is assumed that the spray intensity is expressed in gallons per acre. The expression appears in lines 4640 and

4650 and the factor Q appears in line 4670. If the spray intensity is expressed in liters per hectare or some other set of units, the constants appearing in lines 4640 and 4650 would have to be changed accordingly.

The fraction of the total mass of the spray contained in the i^{th} size class, $(M4)_i$, is calculated in the following way. Let $(M3)_i$ denote the mass of the average drop in the i^{th} size class and let $(M5)_i$ denote the mass of all drops in that class. Then,

$$(M5)_i = (N3)_i (M3)_i$$

and the total mass in the spray, M4, is

$$M4 = \sum_{i=1}^{i=S3} (M5)_i$$

where S3 denotes the number of size classes. Hence,

$$(M4)_i = (M5)_i / M4,$$

and the number of drops in the size class corresponding to a specified drop stain distribution is

$$(A7)_i = (N7)_i (M4)_i \; .$$

If it is assumed that all drops are lethal, P_i, the probability of kill of the drops in the i^{th} class, is the number of drops impinging upon the target or

$$P_i = E(A7)_i$$

where E is the impact efficiency for that drop size. This equation appears in line 4670. The appearance of the intensity factor, Q, in line 4670 has been discussed above.

To enable the reader to better understand the preceding work the following example is presented. The basic data is taken from an ASCAS print out of experimental data obtained from the Beaverhead/ Gallatin Trial #3. This data corresponds to the data used in the attached program. The magnification factors are A=C=0, B=0.5556 and F=1. The ASCAS program provides as input, the stain diameter class boundaries, $(S3)_i$, the mass of the average drop in the class, $(M3)_i$, and the number of drops in the class $(N3)_i$. This data is listed in tabular form in table #2 in columns 1, 2, 5 and 6. Columns 3, 4, 7, 8 and 9 contain the results of the calculations corresponding to the respective equations in this section. The calculation of $(N7)_i$ assumes that Q=1. The tabular results should also be compared to the program results presented in Run 7a on pages 16.13 to 16.16. In the program, the quantities labeled R3(Z) correspond to the quantities $(R3)_i$, the N7(Z) correspond to the $(N7)_i$ and the A7(Z) correspond to the $(A7)_i$. The output listed on pages 16.14 to 16.16, is an example of the

auxiliary detailed output that may be obtained from the program if a 1 is typed in response to the query given by line 1120 of the program. This ability to obtain detailed auxiliary results was provided to assist in the debugging and understanding of the program.

Calculation of Number of Drops/Class From Cumulative Frequency Input Format

This section of the report describes the method for obtaining the number of drops in each size class from the cumulative frequency vs. diameter curve. A size class consists of drops whose diameters lie in a given range. The range will be defined by (D_i, D_{i+1}) where D_i is the minimum diameter and D_{i+1} is the maximum diameter of the drop. Drops whose diameters lie in this range will be said to belong to the i^{th} class.

The cumulative frequency data will be given as a sequence of points (D_i, C_i) where C_i is the cumulative drop frequency corresponding to the i^{th} class size. Thus, the percent of drops in each class is

$$p_i = C_i - C_{i-1} \,. \qquad (1)$$

See line 1725.

For the i^{th} class size, let p_i, n_i and R_i, denote the percent of drops, the number of drops and the average drop diameter in the class respectively. Also let N denote the total number of drops in a spray of Q gallons per acre and v_i denote the volume of a drop of diameter R_i. Then,

$$\sum_i n_i v_i = Q \qquad (2)$$

or

$$\frac{\pi}{6} \sum_i n_i R_i^3 = Q \quad . \tag{3}$$

But

$$n_i = p_i N \tag{4}$$

and hence,

$$\frac{\pi}{6} \sum_i N p_i R_i^3 = Q \quad . \tag{5}$$

Thus, the total number of drops, N is given by

$$N = \frac{Q}{\frac{\pi}{6} \sum_i p_i R_i^3} \quad . \tag{6}$$

Since Q is in units of gallons per acre and it is desired to know the total number of drops falling on 1 sq. cm., the above equation is modified to read

$$N = \frac{1.78642 \times 10^8 Q}{\sum_i p_i R_i^3} \tag{7}$$

where R_i is measured in microns.

In the program p_i is denoted by P3(I) and R_i is denoted by D3(I). Lines 1750-1765 calculate the denominator of equation (2) and line 1770 corresponds to equation (2) with Q=1. In terms of the previous development it is possible to write equation (4) as

$$n_i = \frac{1.78642 \times 10^8}{\Sigma\, p_i R_i^3}\, Q \tag{8}$$

and the probability of kill for the i^{th} size class is

$$P_i = EQ\, \frac{1.78642 \times 10^8}{\Sigma\, p_i R_i^3} \quad . \tag{9}$$

The correspondence of this development with the program is accomplished with the aid of the identifications: $C3(I)=C_i$, $D3(Z)=R_i$, $M4(Z)=(M4)_i$ and $P(Z)=P_i$. It is then seen that lines 4650 to 4670 are equivalent to

$$P_i = E(M4)_i \left\{ \frac{1.78642 \times 10^8}{R_i^3}\, Q \right\} . \tag{10}$$

Equations (9) and (10) are equivalent. This can be shown by noting that

$$M7 = \Sigma\, P_i R_i^3 \quad . \tag{11}$$

From line 1800 we obtain

$$(M4)_i = \frac{P_i R_i^3}{M7} \tag{12}$$

or

$$(M4)_i = \frac{P_i R_i^3}{\Sigma P_i R_i^3} \quad . \tag{13}$$

Substituting equation (13) into equation (10) gives equation (9). Consequently, equations (9) and (10) are equivalent.

The reader may wonder about the absence of such factors as the density, the total number of drops, and other constant factors in equations (10), (11), (12) and (13). These factors are not needed because the desired weighting factor $(M4)_i$ is a ratio of two masses and the missing factors would all cancel out. This may be seen by noting that the mass of the total spray in the i^{th} class is

$$\frac{\pi \rho}{6} N P_i R_i^3$$

where ρ is the density and N is the total number of drops. The total spray mass is then

$$\frac{\pi \rho}{6} N \Sigma P_i R_i^3$$

and the weighting factor is

$$(M4)_i = \frac{P_i R_i}{\Sigma P_i R_i^3} .$$

Thus, line 1800 does indeed give the weighting factor. Furthermore, there is no necessity to include the factor $\pi \rho N/6$ in the calculations in lines 1760 and 1800. The percent conversion factors will also cancel and therefore, they also are not included. Thus, M7 is not the actual mass but rather a relative mass.

For the cumulative frequency vs. drop diameter input format the drops are assumed to be spread continuously over the diameter classes. Hence, the calculation of the diameter of the drop of average size in a size class, $(D3)_i$, is different than the calculation used to calculate the average diameter when the drop data is specified by ASCAS data. The fundamental equation is

$$\frac{\pi}{6} (D3)_i^2 = (\frac{\pi}{6}) \frac{1}{[(S3)_i - (S3)_{i-1}]} \int_{(S3)_{i-1}}^{(S3)_i} D^2 dD$$

$$(D3)_i = \sqrt{\frac{(S3)_i^3 - (S3)_{i-1}^3}{3[(S3)_i - (S3)_{i-1}]}} \quad .$$

Thus, lines 1655 and 1660 are different than lines 3535 and 3540.

As an example of the development described in this section, we use the data in the attached program. The necessary initial data is shown in columns 2 and 4 of table #3. The entries in the fifth column are obtained from

$$(N7)_i = \frac{1.78642 \times 10^8}{R_i^3} Q$$

and the entires appearing in the last column are given by

$$(A7)_i = (M4)_i \ (N7)_i \quad .$$

The quantities $(N7)_i$ are labeled N7(Z) in the program and the entries $(A7)_i$ are denoted by A7(Z). Run 10a, pages 16.21 through 16.24, lists a detailed printout and it is seen that the entries in the last two columns of table #3 correspond to the printed results.

Calculation of the Minimum LD_x Drop Diameter, d

The minimum LD_x drop diameter depends upon the mass of the insecticide in the drop, the body weight of the insect, the concentration of the insecticide in the spray and the density of the pure insecticide.

The units expressing the insecticide dose, D, required to obtain a specified LD_x are given as μgm/gm body weight or as oz./acre. Because of the two different units of measurement, the calculation of the minimum drop diameter, d, necessary to produce a given LD_x is accordingly different. The first part of this section presents the derivation of an expression for d assuming that D is expressed in μgm/gm body weight. d will be determined in microns.

Let: d = minimum drop diameter in microns

D = Required dose in μ gm/gm body weight,

w = Insect body weight in mg,

C = Percent concentration of pure insecticide by volume of spray,

and δ = Density of pure insecticide in gm/cm^3.

The calculation of the desired drop diameter requires a determination of the mass, M, of pure insecticide that must be contained in the drop. Equating this expression to the mass of insecticide actually contained in a single drop gives an equation for the determination of the drop diameter.

The desired dose per insect is

$$Dw \times 10^{-3} \ \mu\text{gm} \quad \text{or} \quad Dw \times 10^{-9} \ \mu\ \text{gm}$$

of pure insecticide. The mass of pure insecticide contained in a spray droplet is

$$\frac{\pi}{6} d^3 \left(\frac{C}{100}\right) \sigma \times 10^{-12} ,$$

where d is in microns.

Thus, by equating these two expressions

$$\frac{\pi}{6} d^3 \left(\frac{C}{100}\right) \sigma \times 10^{-12} = Dw \times 10^{-9}$$

or

$$d^3 = \frac{6\ Dw \times 10^5}{\pi\ C\ \sigma} .$$

Hence,

$$d = 57.5884 \sqrt[3]{\frac{Dw}{C \sigma}} .$$

If the dose is given in oz./acre, the determination of the mass of insecticide that must be contained in a single drop is accomplished by assuming that the spray is spread evenly over the area covering the insects. It is further assumed that the shape of the insect can be approximated by a right circular cylinder

whose length is ℓ_1 cm and whose diameter is ℓ_2 mm. Thus, the area, A, exposed by the insect to the spray is $\ell_1 \ell_2 \times 10^{-1} cm^2$. If D is the dose, M is given as

$$M = 7.0053 \times 10^{-8} \ell_1 \ell_2 D \quad gm.$$

Equating this expression to the mass of insecticide contained in a droplet gives

$$7.0053 \times 10^{-8} \ell_1 \ell_2 D = \frac{\pi}{6} d^3 \left(\frac{C}{100}\right) \sigma \times 10^{-12}$$

or

$$d^3 = \frac{42.032 \times 10^6 \ell_1 \ell_2 D}{\pi C \sigma} .$$

Hence,

$$d = 237.4 \sqrt[3]{\frac{\ell_1 \ell_2 D}{C}} .$$

The program for these calculations is attached and the flowchart shown in figure 8.

Optimal Spray Drop Calculation Program Description and Comments

The program accepts as input the physical characteristics of the air and the drops, together with the drop distribution of a particular spray, and calculates a probability of kill distribution and a total probability of kill. In addition, provision is made for considering a minimum lethal size drop.

The overall organization of the program is displayed in the flowchart depicted in figure 5. The flowchart is self explanatory. Figures 6a, 6b and 6c are a more detailed flowchart of the program. The impact efficiency subroutine is shown in figures 7a and 7b. The numbers appearing in the flowcharts refer to the appropriate line numbers in the program.

The programs have been written in modular fashion in order to make them readily portable to another computer and also to permit easy alterations or additions. This has resulted in a program which appears lengthy; however, the actual 'heart' of the program is relatively short. The generous use of remark statements adds to the lengthy appearance of the program and should enable the reader to easily follow the flow of the calculations. Such a method of programming optimizes the portability of the program to other computers. Portability of programs between computers is a serious and costly problem and every effort has been made to minimize possible difficulties which may arise in the transference of the program. The author deliberately chose simplicity over 'tightness' and 'elegance' in programming style.

Because the experimentally determined drop distribution data may be furnished by the ASCAS computer program or it may be given as a cumulative frequency versus drop diameter curve, the program provides the user with the ability to select the data format appropriate to the problem of interest. The ability to give the user the choice of either type of data format requires that both types of data be stored simultaneously in the program. Since input data is stored in the computer with the aid of a data stack, and the operation of a data stack does not permit completely random access to the data in the stack, additional programming is required to furnish the user the option of choosing the type of data format.

The data appears in the data stack in the order in which the data appears in the program and the data is taken from the stack to be used in the program in the order in which it appears in the stack. This order may not be the same as the order in which it is desired to use the data in the program. Consequently, if it is desired to use the data in an order which is different than the order in which the data is stored in the data stack, it is necessary to first read in all of the data even though the data will not be used immediately, or even at all, in the program. Thus, in this program, data from both types of formats is first read in and then a decision is made as to which data sets will be used in the particular program run. This decision is made with the aid of a switch, F3. The flowchart appearing in figure 6b

may appear unusual because of the indirect method; however, the program does provide the necessary flexibility to the user.

Data Format Comments

The Optimum Drop Size Calculation program will accommodate the two input formats most frequently used in presenting drop distribution data. Drop distribution data may be in the form of a cumulative frequency vs. drop diameter curve or a set of points defining such a curve. Acceptance of this form of drop distribution data is accomplished in lines 1632-1636 and in lines 1702-1706. The other form of drop distribution data is that given by the ASCAS program. The program provides for this format in lines 3270-3274, 3340-3346, and 3440-3446.

For the cumulative frequency vs. diameter format of data input, the actual droplet diameters are given as upper boundaries as opposed to the ASCAS format which gives stain diameter boundaries. The set of actual drop class limit diameters is read in (see line 1625) using the labeling variable S3(I). This is the same variable used to denote the stain diameter boundaries when reading from an ASCAS type format. Because the program uses the magnification factor formula, line 4545, to transform average stain diameters to average drop diameters, the values of the magnification factors, A, B, C and F must be suitably set whenever the S3(I) are actual droplet diameters (i.e. when using the cumulative frequency vs. drop diameter input format). This is done by setting A=C=0 and B=F=1; thus enabling line 4545 to merely relabel the S3(I) to R3(I). This modification of the magnification factors takes place whenever the cumulative frequency vs. drop diameter input format is used and permits both input formats to be accommodated in the same program.

For the attached set of computer runs, the ASCAS data is taken from spray data obtained in the Beaverhead/Gallatin Trial #3 experiment. The spray density was 1.011 gm/ml and the magnification factors were A=0, B=0.5556, C=0 and F=1. The cumulative frequency data is taken from a sample set of data provided by the contract technical monitor. Both of these sets of data are used for illustrative purposes only. If other drop distributions are to be used as a basis for the calculations, they must be entered into the data statements in accord with the preceding instructions. If the acquisition of such data were automated, the modular style of the programming would easily permit the DATA input section of the program to be altered to accommodate the automation.

The User Guide section explains in greater detail the DATA input.

The Minimum Drop Size Calculation program accepts as input the physical and entomological parameters required to determine the minimum lethal drop diameter. These parameters are listed in the section describing the derivation of the minimum drop size and are called for, in proper order, by the program as it requires them. The notation at the beginning of the program listing gives the units of the parameters and the desired drop diameter is calculated in microns. A flowchart of the program appears in figure 8 and the operation of the program is provided by the program as it is run.

USER GUIDE

Data Input

Before the user runs the program, it is necessary to enter as DATA the detailed description of the particular spray. As stated in section 7, there are two formats used in the detailed description of the spray. The first format is that which is produced by the ASCAS computer program. From that program the stain class size diameters in microns, S3(I), may be obtained and are entered as DATA in lines 3270 to 3274. The ASCAS program also gives the number of drops in each size class which are entered as DATA in lines 3340 to 3346 together with the mass of a drop of average size in each class which is entered as DATA in lines 3440 to 3446. The number of classes, or size categories, S3, is entered by the operator as input in line 1597. The second type of format used in the description of a spray is a set of points obtained from a cumulative frequency vs. drop diameter curve. The drop diameter class boundaries are entered as DATA in lines 1632 to 1636 and the cumulative frequencies corresponding to each class boundary are entered as DATA in lines 1702 to 1706. In the event that more than 20 size categories are required to describe the spray distribution, the dimension statements must be altered to accommodate the increase. Presently, up to 20 size classes can be accommodated.

During the course of running the program, the following additional data is required. The density of the air, D2, in lbs./ft.^{3}; the viscosity of the air, V1, in lbs./(ft.sec.); the density of the spray droplet, D1, in lbs./ft.^{3}; the diameter of the target, C1, in inches; the velocity of the air, U1, in miles per hour; and the base spray intensity, Q, in gallons per acre, must all be supplied by the operator. These six pieces of data are entered in lines 4270 and 4340 of the program and are called for by the program via printed instructions on the terminal to the operator.

If the ASCAS input format option is selected, the magnification factors A, B, C and F must be supplied by the operator. They are called for by lines 3155 and 3165. Since the ASCAS computer printout provides the drop diameter and the percent mass by class, the total mass, and the number of drops per size class, it would have been possible to directly enter such data and, as a result save some calculational effort. However, it may be the case that only raw stain data and the attendant magnification factors are available, and hence provision was made for using such data. In addition, the extra calculation required because of the acceptance of this form of the data is very very small and consequently it was not thought worthwhile to omit the capability.

There are several operator options available. The first option appears in line 1120 and allows the operator to obtain a detailed printout of the calculation of the essential quantities necessary to calculate the probability of kill for each size class. These

calculations are performed in lines 4635 to 4672. The quantities printed out are listed in lines 4684 to 4687 and may be identified with the aid of the notation listed at the beginning of the program. Examples of such detailed printouts are given in runs #7a and 10a in the attached set of program results. The second option, which appears in line 1385, permits the specification of a minimum lethal drop diameter. This diameter must be expressed in microns.

The third option permits the designation of either the ASCAS input format or the cumulative frequency vs. the drop diameter input format. The option appears in line 1580. The last option, line 4760, provides the user with the ability to run the program again, using all input variables and data as before, with the exception of the target diameter, the air velocity and the base spray intensity. These latter three parameters are varied most frequently and this option enables a parameter study involving the effects of these three variables to be readily carried out. The option is invoked by typing a 1 in response to the request indicated by line 4760. The output necessary to construct figures 3 and 4 of the Ekblad report is suppressed when this option is exercised. This output is not necessary since the first running of the program provides the output.

Since any combination of choices of these four options is available, the program is quite flexible and, it is hoped, will thus readily accommodate the user. Examples of the use of these options are presented in the attached set of program results.

Data Output

The results of the program are presented in the form of tables containing indices and headings for identification. Some typical results are shown in the attached set of program runs.

Output of Results

The program presents the results as a set of tables whose entries correspond to that displayed graphically in figures 3, 4, 6 and 7 of the report by Ekblad.

Program Results

Results from several runs are given in order to illustrate the different output formats and to also indicate the potential of the program as an aid in studying the variation of the probability of kill with the parameters. For the Optimal Drop Size Program an index of program runs and results is provided on page 16 to enable the identification of the values of the input parameters with the corresponding runs.

The setting of the minimum lethal drop size, L1, equal to zero corresponds to the assumption that every drop is a lethal drop. The setting of L1=134.5 and L1=257.2 corresponds to a topical application of mexacarbate to the 4^{th} and 6^{th} instars respectively at the LD_{90} level. The choices L1=124.8 and 285.8 correspond to spray applications of mexacarbate to the 4^{th} and 6^{th} instars respectively at the LD_{90} level. These insecticide data, together with the target diameter data, are for the spruce budworm and were obtained from the contract monitor. References 3 and 4 illustrate the format in which such data is presented.

Runs 7a and 10a have the same set of parameters as runs 7 and 10 respectively and the purpose of runs 7a and 10a is to illustrate the output produced from lines 4684-4687. This option was provided to enable easier checking of the calculation.

On several of the runs the calculated value of the dimensionless parameter χ exceeded the allowed range. This indicated that the range of the table had been exceeded and consequently, the impact efficiency was set equal to unity. For those runs for which this occurred, the size class together with the value of χ, (called X in the program), was printed out. The exceeding of the

range of the table usually occurs when the target radius is small and the air velocity is large. This is due to the fact that χ varies inversely as the target radius and directly as the air velocity. An illustration of the results furnished by the program when χ has exceeded the allowable range is provided by Run 1, page 16.2. The lower portion of the printout indicates that the range of χ , for this particular run, had been exceeded for all size classes greater than the fifth size class.

The figures referred to in the program listing and in the program output refer to the corresponding figures in the report by Ekblad.

Results from the Minimum Drop Size Calculation program were selected to be illustrative of insecticide test data on the spruce budworms. The program is listed on page 15.11 and typical sets of results are shown on pages 15.12 and 15.13.

Figures 1, 2, 3 and 4 are graphical representations of a portion of each of the results obtained from runs 12-15 respectively of the Optimum Spray Drop Calculation Program. Since the area under the curve is a crude indicator of the overall effectiveness of the spray, it is quite evident that an increase in target diameter considerably reduces the effectiveness of the spray. The graphs also show that there is relatively little change in the spray effectiveness if the drop velocity is increased from one to six miles per hour. Certainly, for much higher velocities it is not expected that this would be the case.

Literature Review

A review and analysis of the relevant literature was made to enable the relating of the present work to that of others. In particular the work concerning the calculation of impact efficiency was reviewed. The original work of Langmuir, et al, ref. 6, used a mechanical differential analyzer to calculate the particle trajectories. Brun, et al, using the theory of Langmuir's as a foundation, obtained more accurate results by using a more accurate differential analyzer. They also showed that the effects of compressibility, for the air speeds of interest, were indeed negligible.

Johnstone, et al, ref. 7, discussed the dispersion and deposition of aerosols. However, their work was devoted primarily to small particles, i.e. those whose diameters were less than 100 microns. They used a diffusion model whose validity becomes more questionable as the particle size increases. In a review article entitled, "Filtration of Aerosols by Fibrous Media", Chen, ref. 8, summarizes the various parameters affecting the calculation of the impact efficiency. Some of the parameters are: inertia, Brownian motion (for very small particles), settling, diffusion and the effect of a collection of particles on the overall flow pattern. This article is a good review article up to 1955.

Dorman, in a chapter entitled, "Filtration", in the text edited by Davies, ref. 9, discusses the parameters affecting the calculation of the impact efficiency. In addition to the many parameters considered by Chen, Dorman also considers sedimentation, electrical effects, packing density and clogging effects. Both Chen and

Dorman's articles have quite complete bibliographies. In the same text, the chapter by Pich entitled, "Theory of Aerosol Filtration by Fibrous Membrane Filters" is very inclusive. The article contains a good summary of the comparison of experimental and theoretical results together with a very extensive bibliography. Davies, in the same text, considers the deposition from moving aerosols. His work contains only a small section on calculation methods for obtaining the impact efficiency. The work of Green and Lane, ref. 10, covers much of the same material, only in a more general setting.

Many other articles were also surveyed. However, they were not found to be sufficiently closely related to the present work and so are not included in this discussion. Some other articles that may be of interest are listed as references 11, 12 and 13 respectively.

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Summary

The present work describes the rationale and the development of a computer program which implements the predictive technique of R. Ekblad for prescribing optimal air dispersal of sprays. As stated in the technical approach section, several important factors have been omitted from the analysis and hence from the program. Both the author and Mr. Ekblad plan to extend the analysis to include these effects.

An examination of the results of the program runs illustrates the flexibility of the analysis and the program. Since the intent of this work was to develop the computer program and to document this development, as well as to demonstrate the program results, no parameter study was attempted. Consequently, an analysis of the effect on the probability of kill due to a variation of the spray parameters will not be presented.

K \ ϕ	0	100	1000	5000	10000	50000
0	0	0	0	0	0	0
.25	.051	.038	.025	.020	.016	.011
.5	.205	.157	.116	.08	.07	.038
1.0	.380	.309	.250	.205	.157	.105
2.0	.57	.49	.43	.36	.30	.22
4.0	.741	.680	.616	.54	.480	.378
8.0	.865	.81	.748	.695	.647	.447
16.0	.920	.87	.830	.79	.755	.682
40.0	.957	.924	.885	.87	.848	.795
100.0	.98	.96	.93	.92	.905	.873
320.0	.995	.985	.97	.96	.952	.940

Table 1

Impact Efficiency (Brun et al)

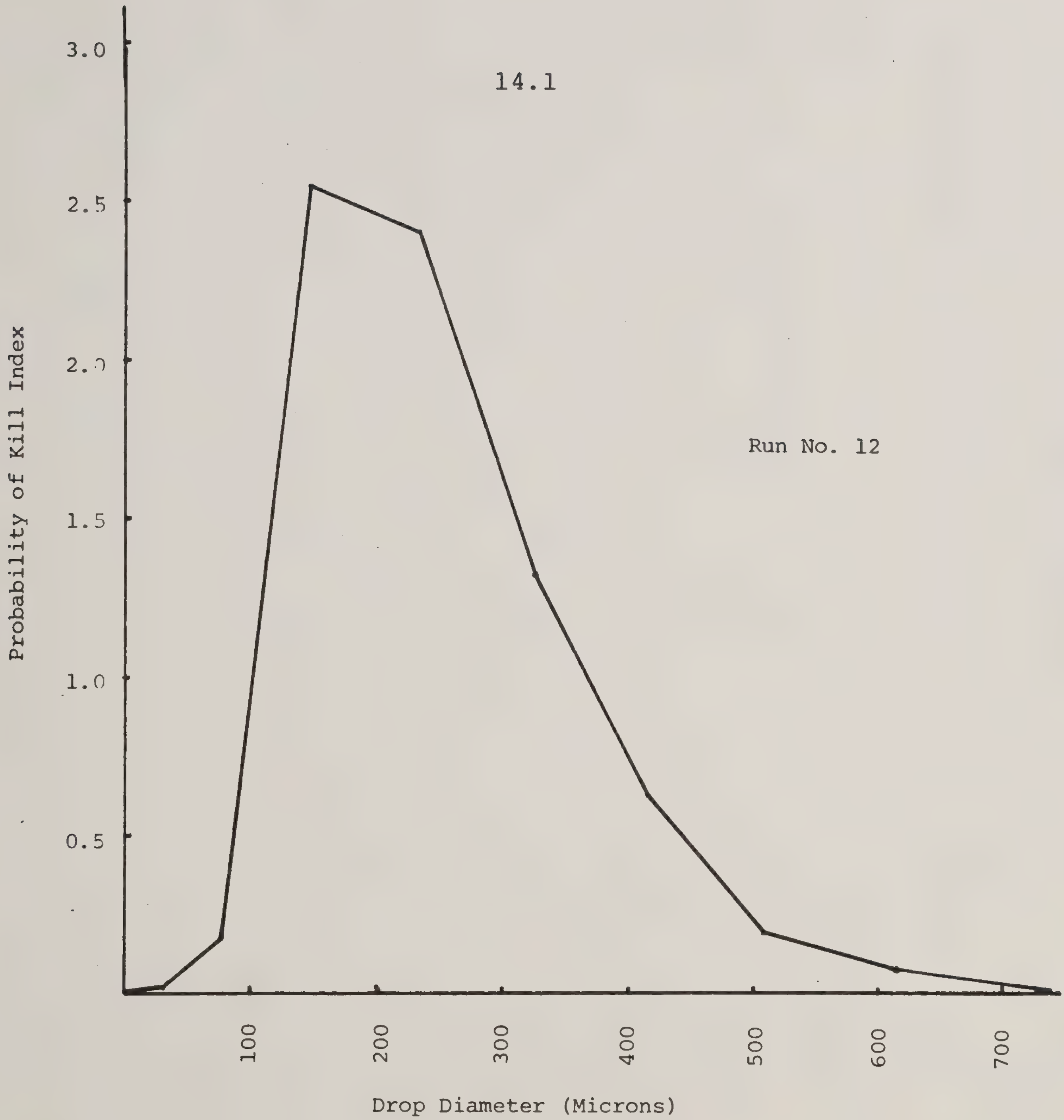
I	$(S3)_i$	$(R3)_i$	$(N7)_i$	$(M3)_i$	$(N3)_i$	$(M5)_i$	$(M4)_i$	$(A7)_i$
1	102	32.719	5100.12	1.854-08	584,408	.00108	.000503	2.564
2	177	78.684	366.711	2.579-07	201,277	.05191	.002416	.8860
3	338	145.624	57.848	1.635-06	601,403	.98759	.04596	2.6587
4	502	235.088	13.750	6.878-06	558,671	3.84254	.17884	2.4591
5	664	325.219	5.693	1.821-05	327,045	5.95549	.27719	1.4395
6	832	416.728	2.469	3.831-05	141,792	5.43205	.25283	.6241
7	998	509.340	1.352	6.995-05	42,489	2.97211	.13833	.1870
8	1212	615.166	.7674	1.232-04	14,810	1.8246	.08492	.0652
9	1448	740.187	.441	2.147-04	1,947	.41802	.02179	.0096
10	1651	861.791	.279	3.388-04	0	0	0	0
11	1996	1014.91	.171	5.534-04	0	0	0	0
12	2313	1198.39	.104	9.111-04	0	0	0	0
13	2671	1386.02	.067	1.409-03	0	0	0	0
14	3003	1577.41	.046	2.078-03	0	0	0	0
15	3239	1734.72	.034	2.763-03	0	0	0	0
16	3693	1927.37	.025	3.790-03	0	0	0	0

SAMPLE CALCULATION FROM ASCAS DATA
Table #2

I	$(S3)_i$	R_i	C_i	P_i	$(M4)_i$	$(N7)_i$	$(A7)_i$
1	21.4	12.355	19.18	19.18	.000196	94720.04	18.565
2	34.1	27.991	30.24	11.06	.001312	8146.01	10.688
3	61.5	48.450	50.3	20.06	.012342	1570.73	19.386
4	89.4	75.879	65.32	15.02	.035499	408.90	14.516
5	116.9	103.455	76.79	11.47	.068707	161.34	11.085
6	145.5	131.459	84.28	7.49	.092053	78.634	7.238
7	173.7	159.808	89.83	5.55	.122539	43.77	5.364
8	210.1	192.187	95.15	5.32	.212442	25.166	5.346
9	250.2	230.441	98.38	3.23	.213830	14.598	3.121
10	284.7	267.635	99.28	0.9	.093338	9.319	.870
11	343.4	314.507	99.84	0.56	.094246	5.742	.541
12	397.2	370.626	99.95	0.11	.030296	3.509	.106
13	458.1	428.011	99.99	0.04	.016967	2.278	.039
14	514.5	486.572	100.00	0.01	.006232	1.541	.010
15	554.7	534.726	100.00	0	0	1.168	0
16	631.8	593.667	100.00	0	0	.854	0

Sample Drop Distribution Calculation
from Cumulative Frequency Data Input

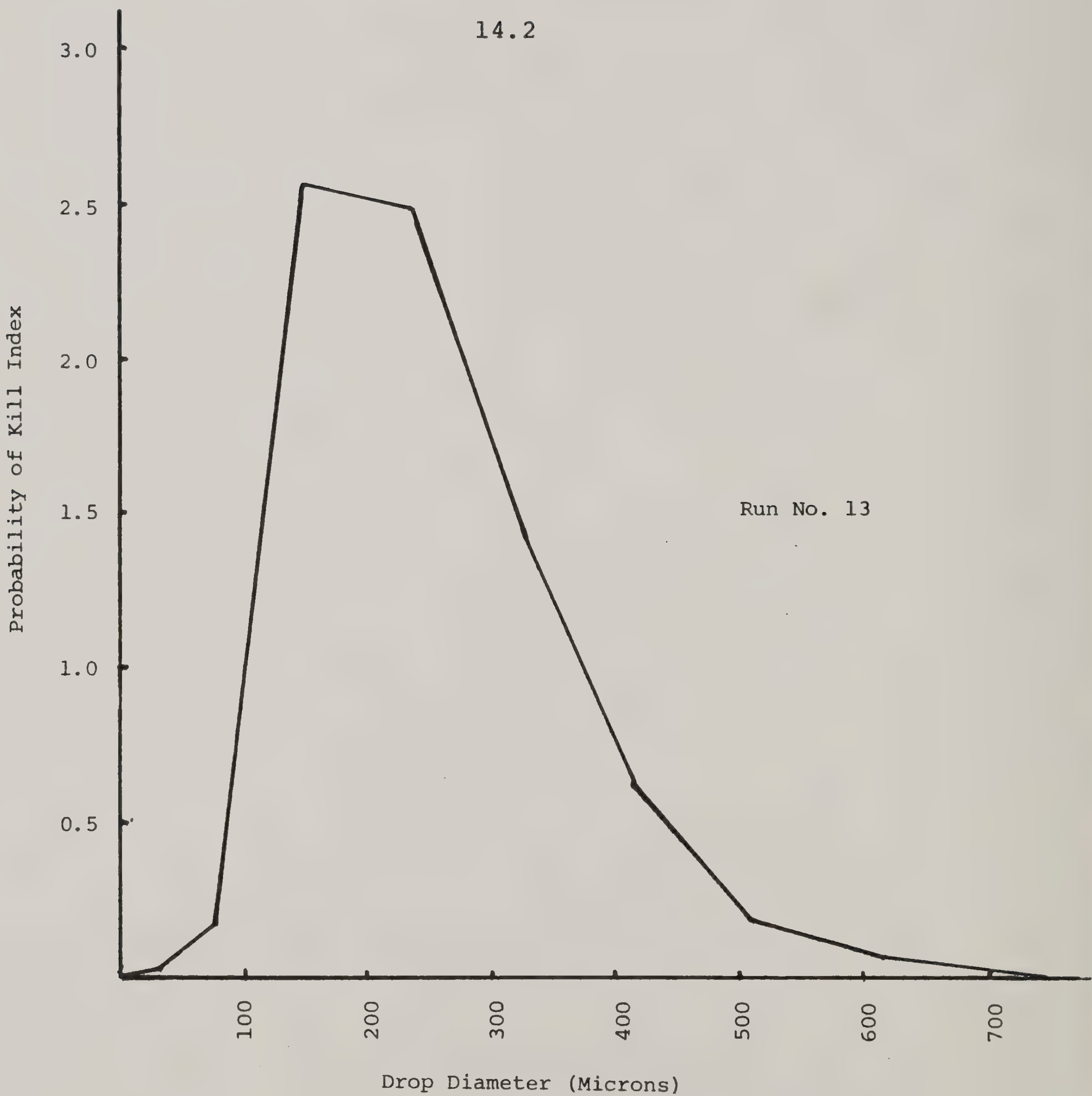
Table #3



Probability of Kill for Spray of One Gallon Per Acre

Fig. 1

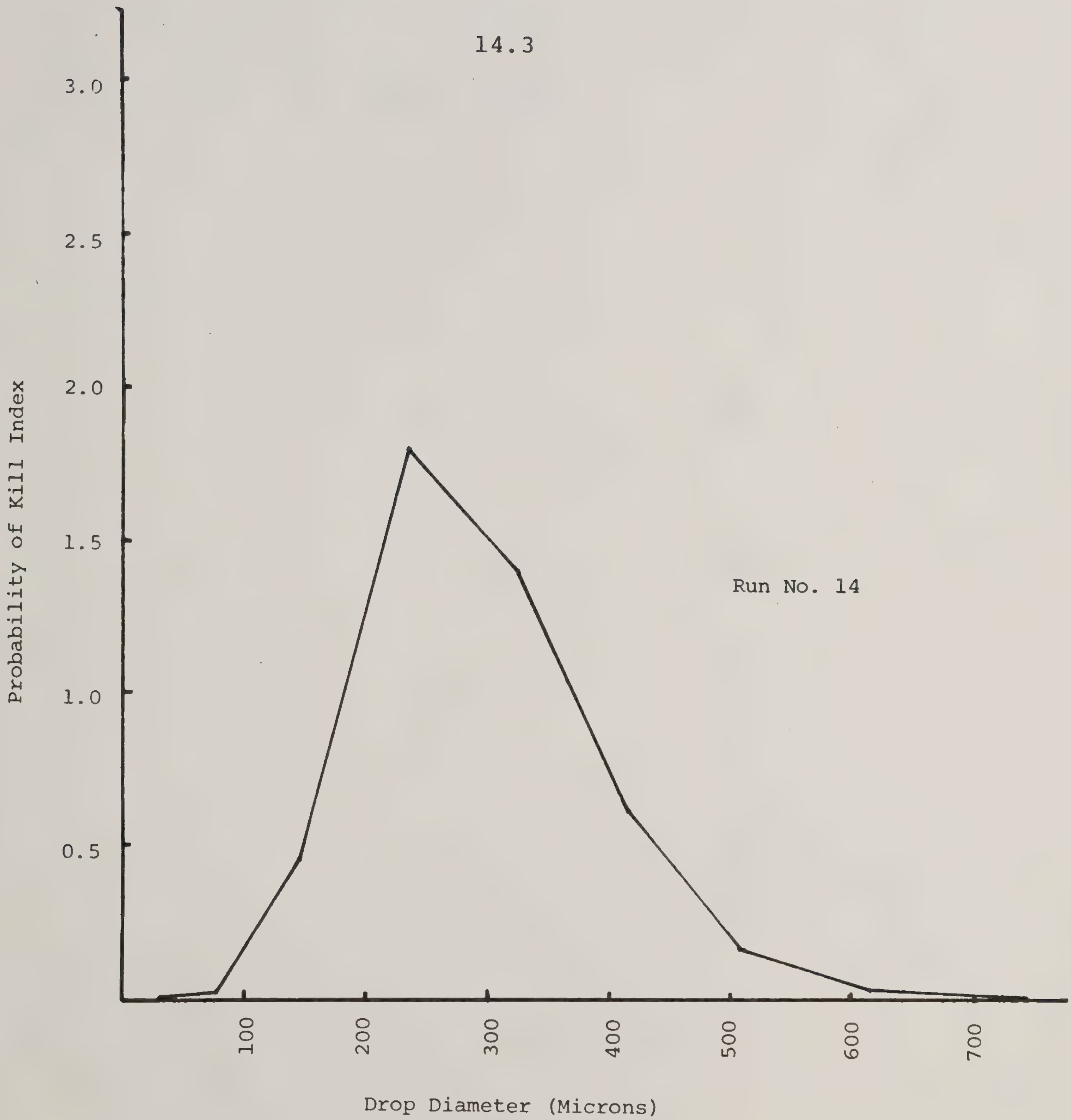
Total Prob. of Kill Index = 7.46
Air Velocity = 1 mph
Target Diameter = .03937 inches



Probability of Kill for Spray of One Gallon Per Acre

Fig. 2

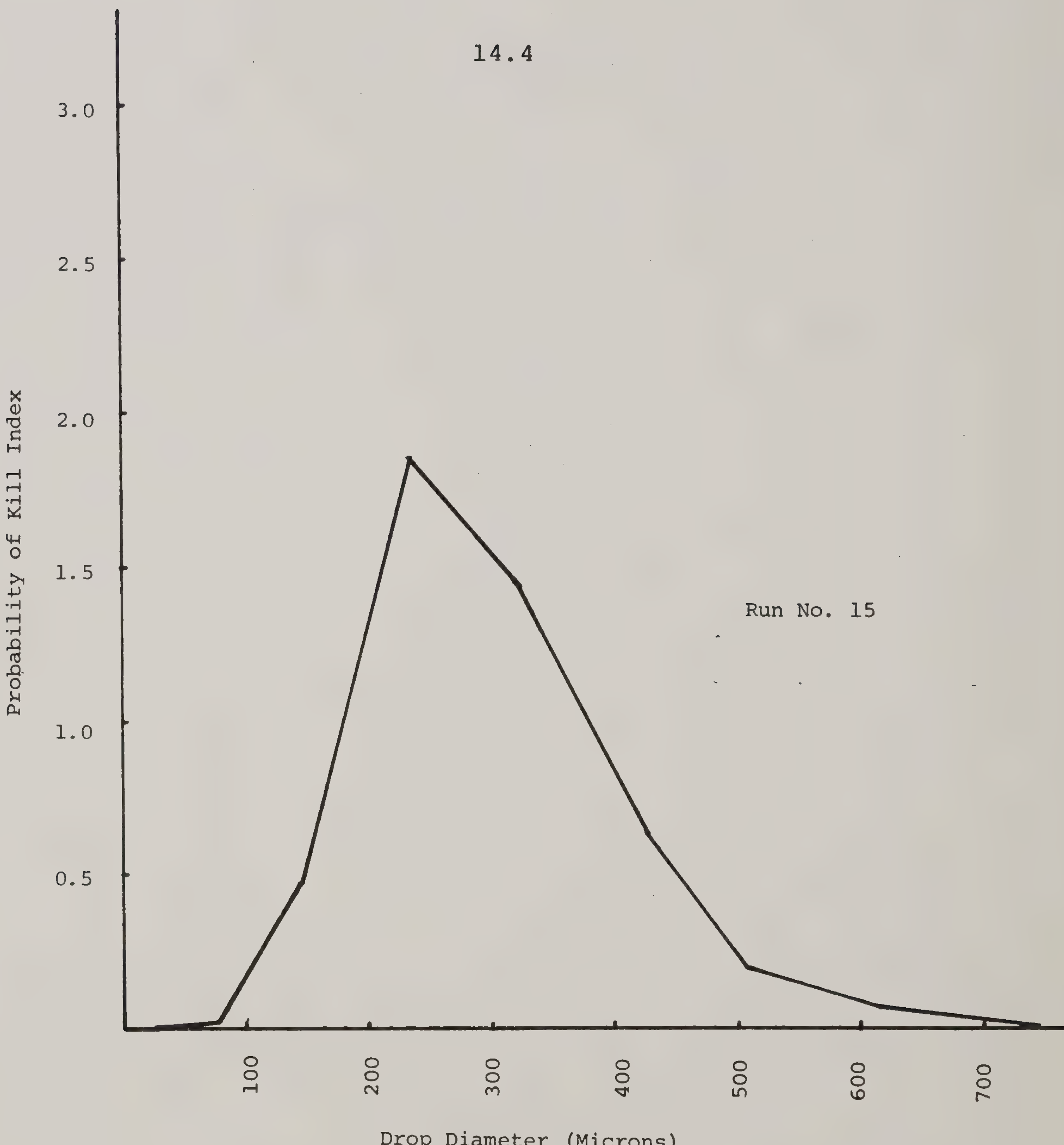
Total Prob. of Kill Index = 7.62
Air Velocity = 6 mph
Target Diameter = .03937 inches



Probability of Kill for Spray of One Gallon Per Acre

Fig. 3

Total Prob. of Kill Index = 4.55
Air Velocity = 1 mph
Target Diameter = .11811 inches



Probability of Kill for Spray of One Gallon Per Acre

Fig. 4

Total Prob. of Kill Index = 4.67
Air Velocity = 6 mph
Target Diameter = .11811 inches

14.5

OVERALL FLOWCHART

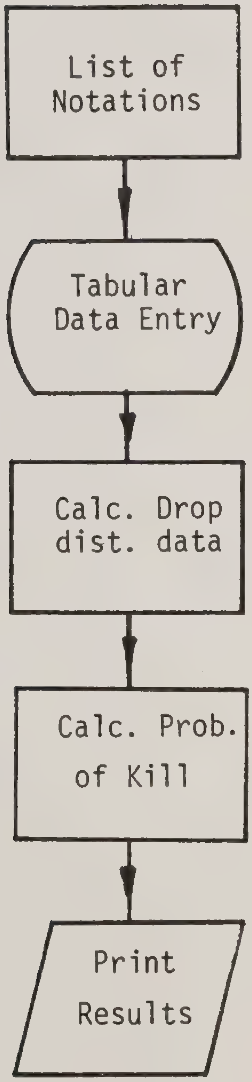


Fig. 5

DETAILED FLOWCHART

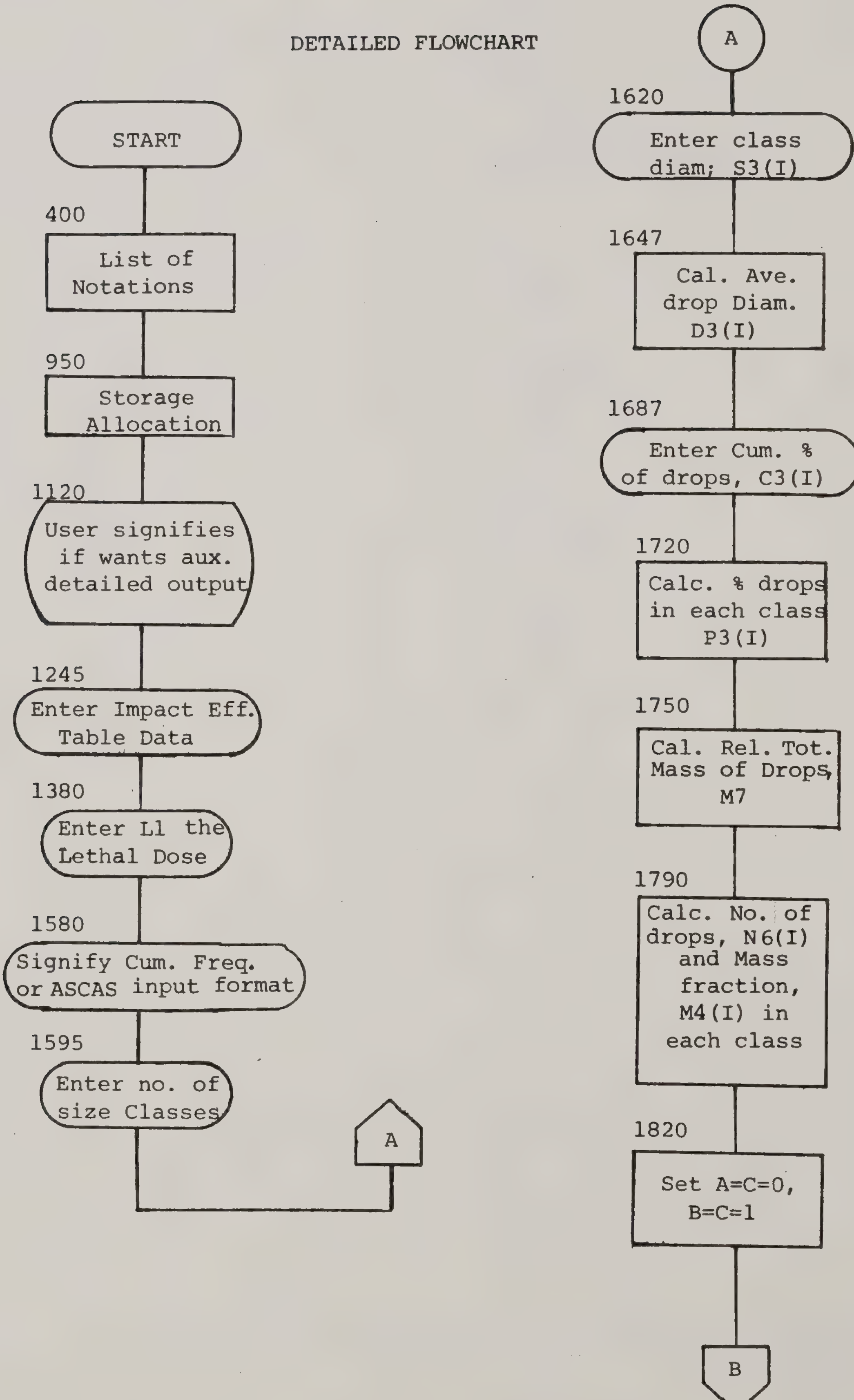
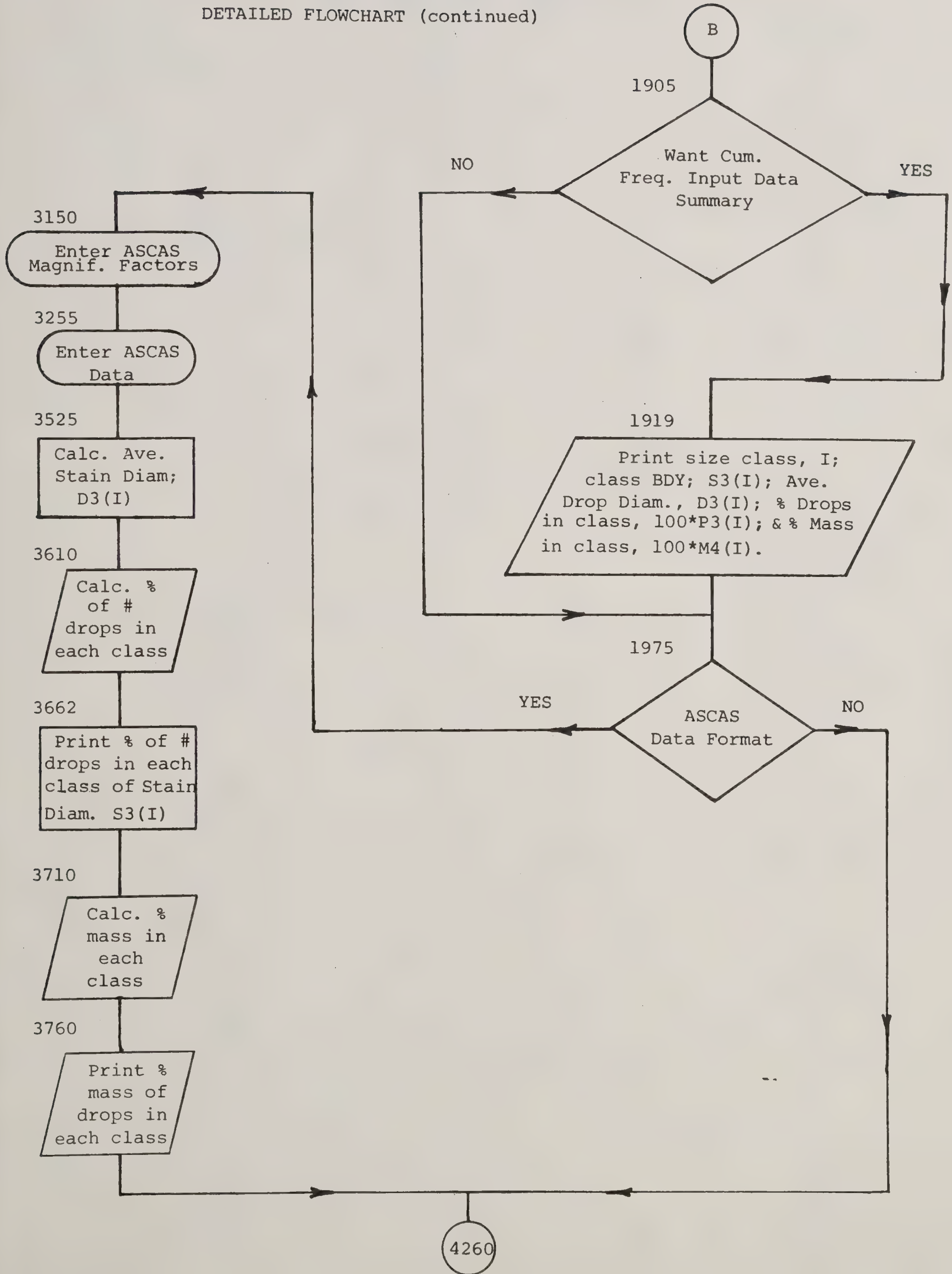


Fig. 6a

DETAILED FLOWCHART (continued)



DETAILED FLOWCHART (continued)

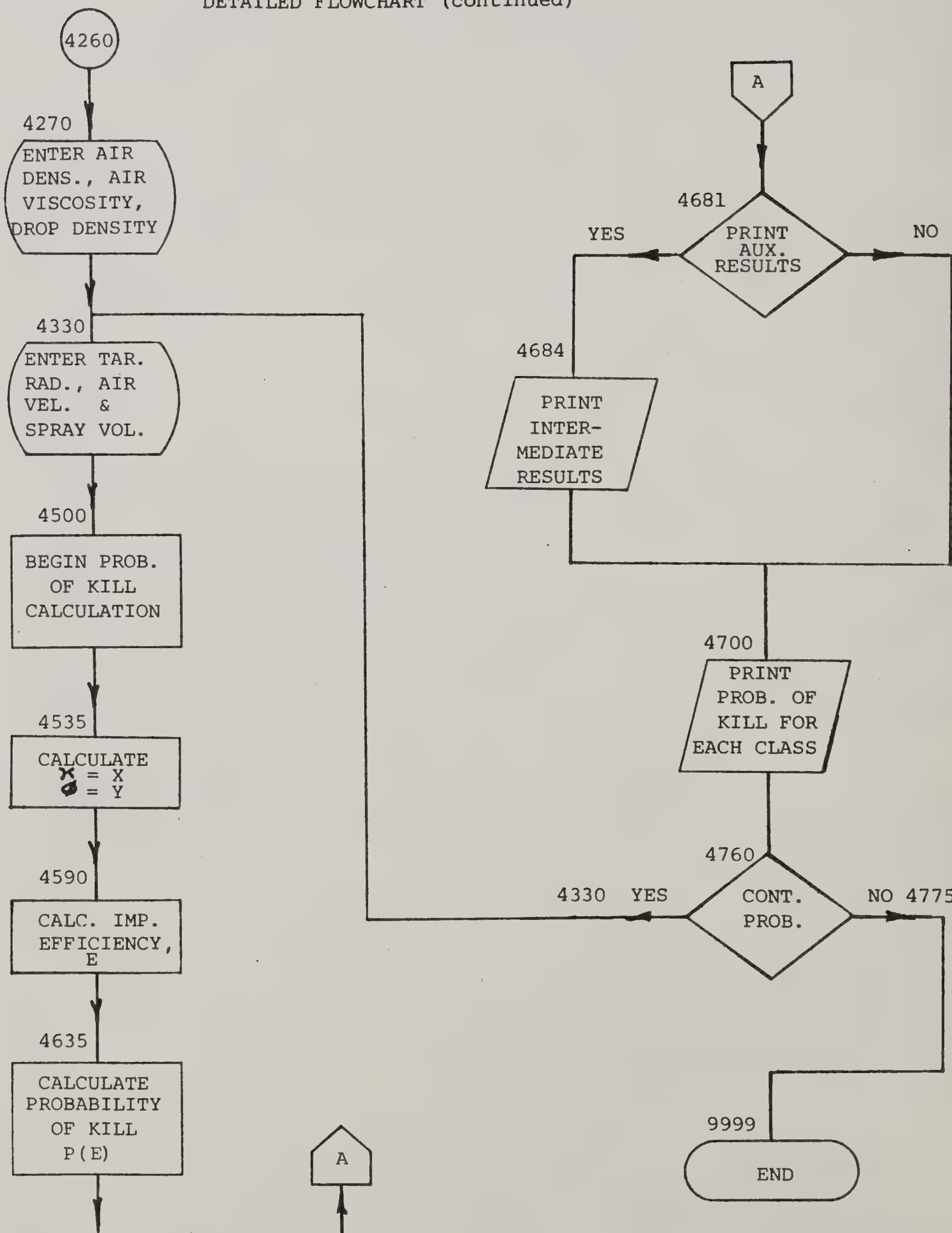
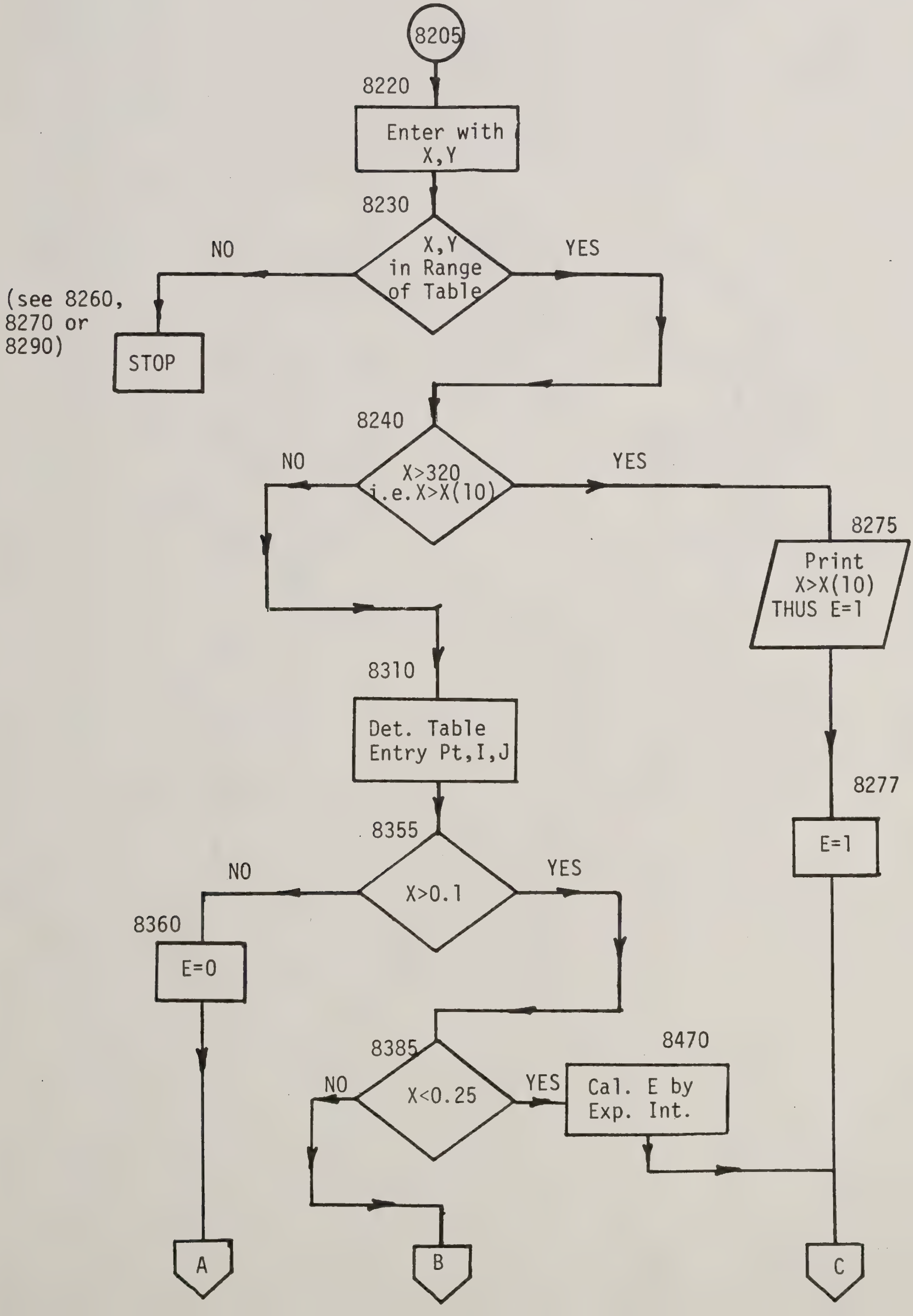


Fig. 6c

Impact Efficiency Subroutine



Impact Efficiency Subroutine (continued)

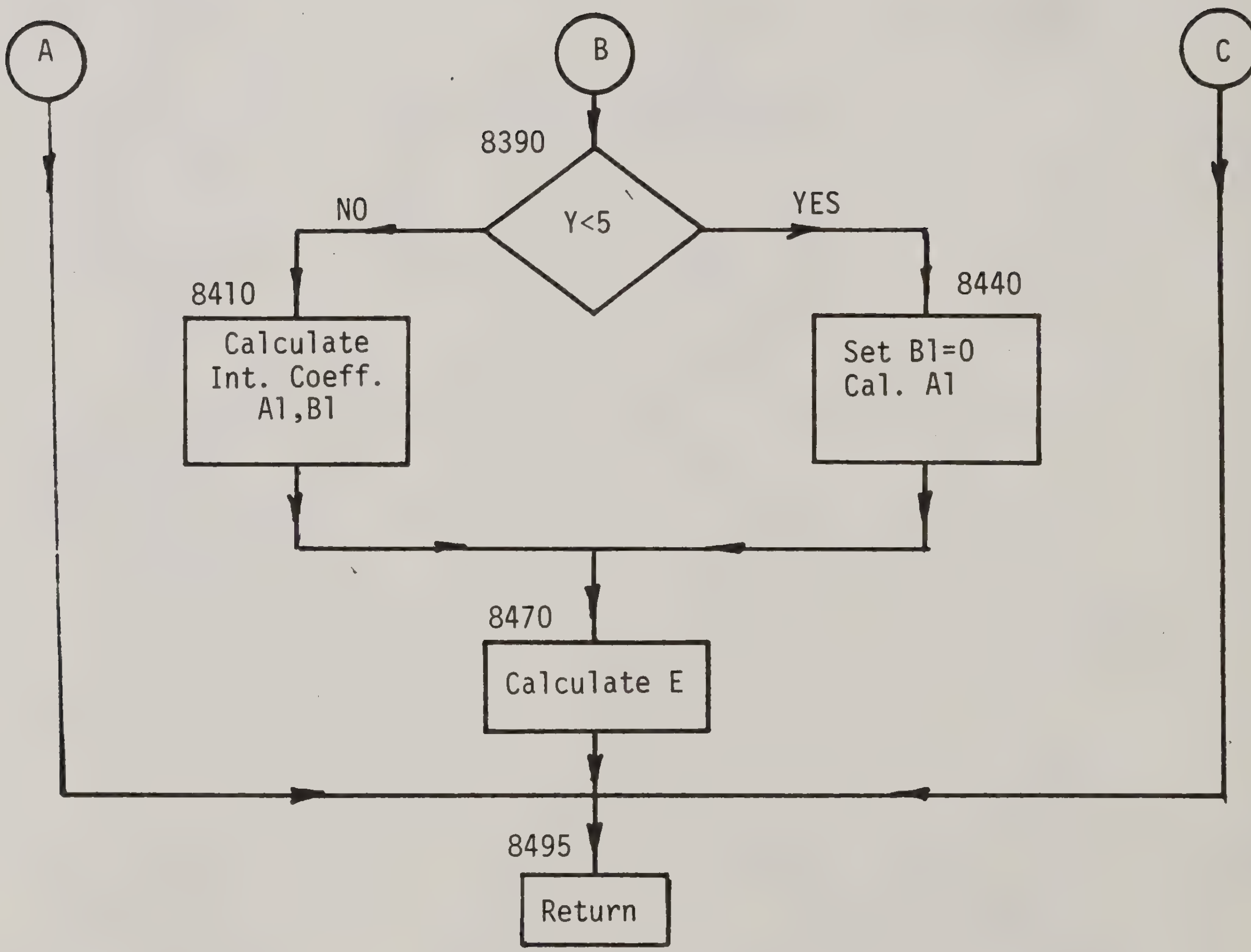


Fig. 7b

Minimum Drop Size Calculation

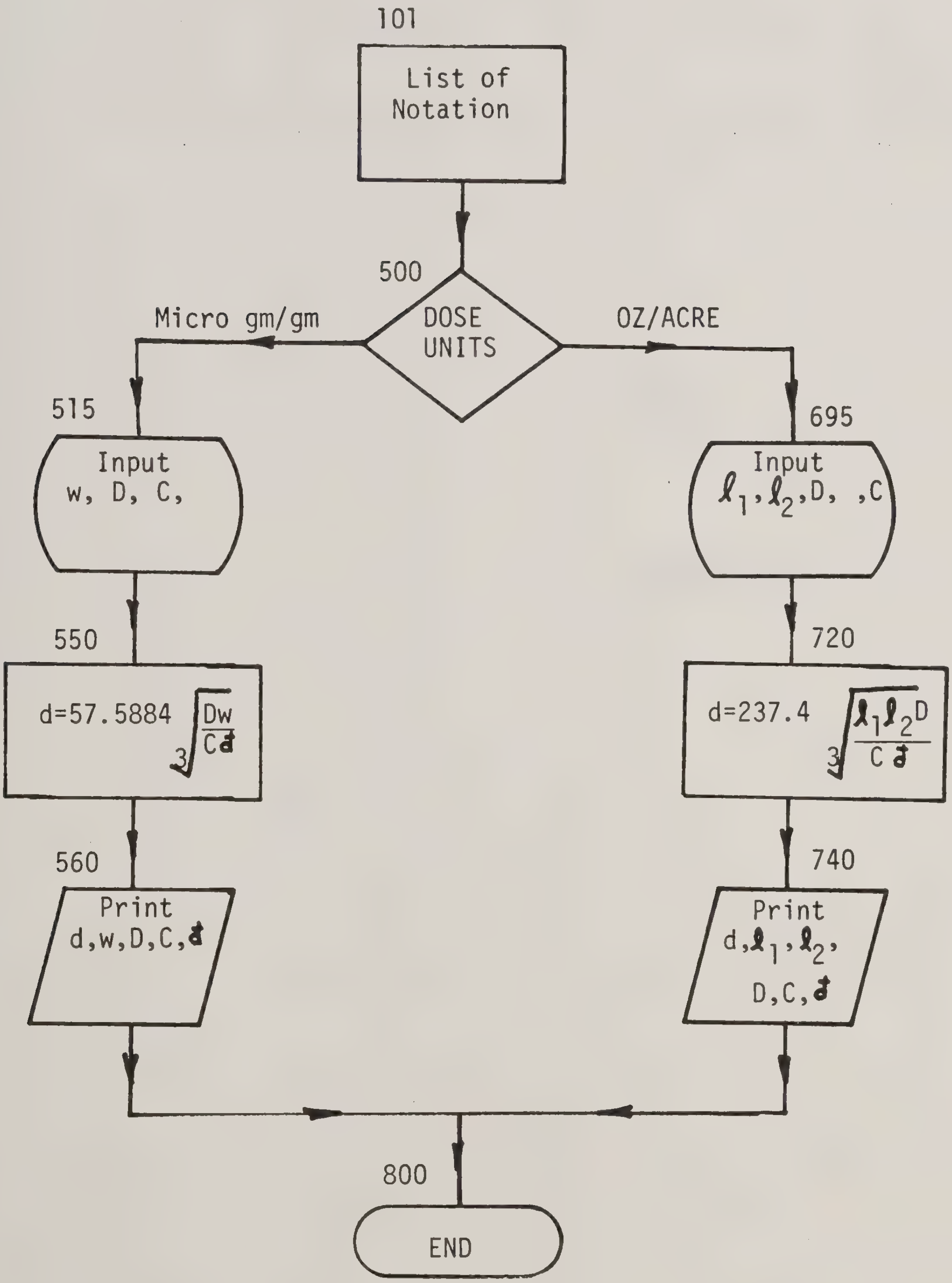


Fig. 8

```
10 REM
15 REM            OPTIMUM SPRAY DROP CALCULATION
20 REM
25 REM
400 REM     NOTATION USED IN THE PROGRAM (IN ORDER OF APPEARANCE)
401 REM
402 REM
403 REM
405 REM           OPERATOR INPUT VARIABLES  &  CONSTANTS
406 REM
407 REM
410 REM    R3  &  R7  =  SWITCH VARIABLES FOR OPTIONAL OUTPUT
415 REM
420 REM     L1  =  MINIUM LETHAL DOSE DIAMETER  (MICRONS)
423 REM
425 REM     F3  =  SWITCH VARIABLE FOR TYPE OF DATA FORMAT
427 REM
430 REM      F  =  PHOTO-REDUCTION FACTOR
435 REM
440 REM    A, B, C  =  EXPERIMENTAL DATA CONVERSION FACTORS
445 REM
450 REM     S3  =  NUMBER OF SIZE CLASSES
455 REM
460 REM     D2  =  AIR DENSITY IN LBS./(FT.^3)
465 REM
470 REM     V1  =  AIR VISCOSITY IN LBS./(FT. SEC.)
475 REM
480 REM     D1  =  DROP DENSITY IN LBS./(FT.^3)
483 REM
485 REM     C1  =  TARGET DIAMETER IN INCHES
495 REM
500 REM     U1  =  FREE STREAM OR DROP VEL. IN MILES/HOUR
505 REM
510 REM      S  =  SWITCH TO PERMIT OPTION OF RUNNING PROG. AGAIN
515 REM
520 REM
525 REM
600 REM           PROGRAM SUBSCRIPTED VARIABLES
605 REM
610 REM     X(I),  Y(I)  =  IMPACT EFFICIENCY COORDINATES
615 REM
620 REM    E(I,J)  =  IMPACT EFFICIENCY TABLE ENTRY
625 REM
630 REM     S3(I)  =  AVE. STAIN DIAM. OF ITH. CLASS IN MICRONS
635 REM
640 REM     N3(I)  =  NUMBER OF STAINS IN ITH CLASS
645 REM
650 REM     M3(I)  =  MASS OF SINGLE AVERAGE DROP IN ITH. CLASS
655 REM
660 REM     D3(I)  =  AVE. STAIN DIAM. OF ITH CLASS IN MICRONS
662 REM
```

Fig. 9a

```
664 REM     C3(I)  =  CUMULATIVE DROP FREQUENCY OF ITH. CLASS
665 REM
668 REM     P3(I)  =  % DROPS IN THE ITH. CLASS
669 REM
670 REM     P7(I)  =  % OF TOT. NO. OF STAINS IN ITH. CLASS
675 REM
680 REM     R3(Z)  =  AVE. DROP DIAM. OF ZTH. CLASS
685 REM
690 REM     N7(I)  =  NO. OF DROPS OF SIZE R3(I)
695 REM
700 REM     A7(Z)  =  NO. OF DROPS/CLASS ACCORDING TO DROP FREQ. DISTR.
705 REM
710 REM      P(Z)  =  PROBILITY OF KILL INDEX FOR ZTH. CLASS
715 REM
720 REM    M4(I)  =  FRACTION OF MASS SPRAY IN THE ITH. CLASS
725 REM
730 REM    M5(I)  =  MASS OF DROPS IN THE ITH. CLASS
732 REM
734 REM    N6(I)  =  NO. OF DROPS IN THE ITH. CLASS, CUM. FREQ. INPUT
736 REM
740 REM
800 REM       TEMPORARY AUXILLARY CALCULATION CONSTANTS
805 REM
810 REM    S1  &  S2  ARE USED IN THE AVE. CLASS SIZE CALCULATION
812 REM
814 REM       M7  =  TOTAL MASS OF SPRAY (ASSUMING UNIT DENSITY)
816 REM
818 REM       M4  =  TOTAL MASS OF SPRAY  (ASSUMING UNIT DENSITY)
820 REM
822 REM       N4  =  TOTAL NUMBER OF RECORDED DROPS
824 REM
826 REM       C2  =  TARGET RADIUS IN FEET
828 REM
830 REM        X  =  KAPPA,  A DIMENSIONLESS IMP. EFF. PARAMETER
835 REM
840 REM        Y  =  PHI, A DIMENSIONLESS IMP. EFF. PARAMETER
845 REM
850 REM        E  =  IMPACT EFFICIENCY
855 REM
860 REM        T  =  TOTAL PROBABILITY OF KILL INDEX
865 REM
870 REM     A1  &  B1  =  INTERPOLATION COEFFICIENTS IN IMP. EFF. SUB.
875 REM
880 REM
885 REM
950 DIM C3(20),P3(20)
955 DIM S3(20),N3(20),M3(20),A7(20),P(20)
960 DIM D3(20),P7(20),N7(20),R3(20)
965 DIM M4(20),M5(20),N6(20)
970 DIM X(20),Y(20),E(20,20)
1104 REM
1105 REM                LINES 1120-1145 ALLOW OPT. AUX. CALC. OUTPUT
1106 REM
1120 PRINT "TYPE  1  IF WANT LINES 4684-4687 PRINTED; ELSE TYPE 0."
1125 INPUT R3
1126 PRINT
```

Fig. 9b

```
1127 PRINT
1130 IF R3=1GO TO 1145
1131 REM
1132 REM             R7  USED AS A SWITCH IN LINE 4681
1133 REM
1135 LET R7=0
1140 GO TO 1245
1145 LET R7=1
1154 REM
1155 REM         LINES 1245-1360 ENTER IMP. EFF. TABLE DATA
1160 REM
1245 FOR I=0 TO 10
1250 READ X(I)
1255 NEXT I
1260 DATA 0,.25,.5,1,2,4,8,16,40,100,320
1265 FOR I=0 TO 5
1270 READ Y(I)
1275 NEXT I
1280 DATA 0,100,1000,5000,10000,50000
1285 FOR I=0 TO 10
1290 FOR J=0 TO 5
1295 READ E(I,J)
1300 NEXT J
1305 NEXT I
1310 DATA 0,0,0,0,0,0
1315 DATA .051,.038,.025,.02,.016,.011
1320 DATA .205,.157,.116,.08,.07,.038
1325 DATA .38,.309,.25,.205,.157,.105
1330 DATA .57,.49,.43,.36,.3,.22
1335 DATA .741,.68,.616,.54,.48,.378
1340 DATA .865,.91,.748,.695,.647,.447
1345 DATA .92,.87,.83,.79,.755,.682
1350 DATA .957,.924,.885,.87,.848,.795
1355 DATA .98,.96,.93,.92,.905,.873
1360 DATA .995,.985,.97,.96,.952,.94
1369 REM
1370 REM         LINES 1380-1385 INPUT MINIMUM LETHAL DOSE, L1.
1371 REM
1380 PRINT "TYPE MINIMUM LETHAL DOSE, L1; IF NO MIN. L.D., TYPE 0."
1385 INPUT L1
1386 PRINT
1388 PRINT
1565 REM
1570 REM      LINES 1580-1585 DECIDE FREQ. DATA INPUT FORMAT.
1575 REM
1580 PRINT "TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0."
1581 REM
1582 REM      F3 USED AS A SWITCH IN LINES L905 AND L975.
1583 REM
1585 INPUT F3
1586 PRINT
1595 PRINT "TYPE   NO. OF SIZE CLASSES, S3."
1597 INPUT S3
1599 PRINT
```

Fig. 9c

```
1609 REM
1610 REM  LINES 1620-1630 READ IN DROP SIZE BOUNDARIES (C. F. FORMAT)
1611 REM
1614 REM
1615 REM     DROP SIZE BOUNDARIES IN LINES 1632-1636 MUST BE
1616 REM     CHANGED FOR EACH NEW SET OF EXPERIMENTAL DATA
1617 REM
1620 FOR I=1 TO S3
1625 READ S3(I)
1630 NEXT I
1632 DATA 21.4,34.1,61.5,89.4,116.9,145.5,173.7
1634 DATA 210.1,250.2,284.7,343.4,397.2,458.1
1636 DATA 514.5,554.7,631.8
1641 REM
1643 REM    LINES 1647-1670 CALC. AVE. DROP DIAM, D3(I).
1644 REM     ASSUMES SMALLEST DIAM. = 0.
1645 REM
1647 LET D3(1)=.57735*S3(1)
1650 FOR I=2 TO S3
1655 LET S1=S3(I)^3-S3(I-1)^3
1660 LET S2=3*(S3(I)-S3(I-1))
1665 LET D3(I)=SQR(S1/S2)
1670 NEXT I
1674 REM
1675 REM  LINES 1687-1700 INPUT CUMULATIVE FREQUENCY PER CLASS,  C3(I).
1676 REM
1677 REM           LINES 1702-1706 MUST BE CHANGED FOR
1678 REM           EACH NEW SET OF EXPERIMENTAL DATA
1679 REM
1680 REM        LINES 1687-1700 READ IN CUM. FREQ. PER CLASS,  C3(I).
1685 REM
1687 LET C3(0)=0
1690 FOR I=1 TO S3
1695 READ C3(I)
1700 NEXT I
1702 DATA 19.18,30.24,50.3,65.32,76.79,84.28
1704 DATA 89.83,95.15,98.38,99.28,99.84,99.95
1706 DATA 99.99,100,100,100
1711 REM
1713 REM     LINES 1720-1730 CALC. % DROPS IN ITH. CLASS, P3(I).
1715 REM
1720 FOR I=1 TO S3
1725 LET P3(I)=.01*(C3(I)-C3(I-1))
1730 NEXT I
1735 REM
1740 REM        LINES 1750-1770 CALCULATE TOTAL NUMBER OF DROPS, N.
1742 REM
1745 REM        M7  IS A RELATIVE MASS
1746 REM
```

Fig. 9d

```
1750 LET M7=0
1755 FOR I=1 TO S3
1760 LET M7=M7+P3(I)*(D3(I)^3)
1765 NEXT I
1766 REM
1767 REM          LINES  1770  &  1795  NOT REQUIRED IN CALCULATION.
1768 REM
1770 LET N=(1.78642E+08)/M7
1775 REM
1780 REM   LINES 1790-1805 CALC. NO. OF DROPS IN ITH. CLASS, N7(I).
1781 REM
1782 REM   LINE 1800 CALCULATES MASS FRACTION IN ITH. CLASS, M4(I).
1785 REM
1790 FOR I=1 TO S3
1795 LET N6(I)=P3(I)*N
1800 LET M4(I)=P3(I)*(D3(I)^3)/M7
1805 NEXT I
1807 REM
1810 REM         LINES 1820-1835 SET MAGNIFICATION FACTORS.
1815 REM
1820 LET A=0
1825 LET B=1
1830 LET C=0
1835 LET F=1
1890 REM
1895 REM        IF F3=1 SKIP PRINTING CUM. FREQ. BASED OUTPUT
1900 REM
1905 IF F3=0GO TO 1975
1910 REM
1915 REM            LINES 1930-1950 PRINT OUTPUT FOR FIGS. 3 & 4.
1917 REM
1918 PRINT
1919 PRINT "        CALCULATIONS BASED UPON CUM. FREQ. VS. DIAM. FORMAT."
1920 REM
1921 PRINT
1925 PRINT
1930 PRINT "SIZE CATE.   BDY. DIAM.     AVE.DIAM.        % DROPS        % M
ASS"
1932 PRINT " I                  S3(I)          D3(I)       100*P3(I)        100
*M4(I)"
1935 PRINT
1940 FOR I=1 TO S3
1945 PRINT I,S3(I),D3(I),100*P3(I),100*M4(I)
1950 NEXT I
1955 PRINT
1960 PRINT "THE ABOVE RESULTS ARE USED IN FIGS. 3 & 4."
1965 PRINT
1970 PRINT
1975 IF F3=1GO TO 4260
3139 REM
3140 REM           LINES 3150-3446 INPUT ASCAS FORMAT DATA
3141 REM
3150 PRINT "TYPE PHOTO-REDUCTION FACTOR, F."
3155 INPUT F
```

Fig. 9e

```
3156 PRINT
3160 PRINT "TYPE THE MAGNIFICATION FACTORS A, B & C."
3165 INPUT A,B,C
3166 PRINT
3249 REM
3250 REM      LINES 3255-3265 READ IN CLASS SIZE DIAMETERS, S3(I).
3251 REM
3252 REM          LINES 3270-3274 MUST BE CHANGED FOR
3253 REM          EACH NEW SET OF CLASS SIZE DIAMETERS
3254 REM
3255 FOR I=1 TO S3
3260 READ S3(I)
3265 NEXT I
3270 DATA 102,177,338,502,664
3272 DATA 832,998,1212,1448,1651
3274 DATA 1996,2313,2671,3003,3239,3693
3304 REM
3305 REM    · LINES 3310-3330 READ IN NO. OF DROPS/CLASS, N3(I).
3306 REM
3307 REM          LINES 3340-3346 MUST BE CHANGED FOR
3308 REM          EACH NEW SET OF NUMBERS OF DROPS/CLASS
3309 REM
3310 FOR I=1 TO S3
3320 READ N3(I)
3330 NEXT I
3340 DATA 584408,201277,601403,558671
3342 DATA 327045,141792,42489,14810
3344 DATA 1942,0,0,0
3346 DATA 0,0,0,0
3404 REM
3405 REM  LINES 3410-3430 READ IN MASS OF AVE. DROP IN CLASS, M3(I).
3406 REM
3407 REM          LINES 3440-3446 MUST BE CHANGED FOR EACH
3408 REM          NEW SET OF MASSES OF AVE. DROP IN A CLASS
3409 REM
3410 FOR I=1 TO S3
3420 READ M3(I)
3430 NEXT I
3440 DATA 1.85400E-08,2.57900E-07,1.63500E-06,6.87800E-06
3442 DATA 1.82100E-05,3.83100E-05,6.99500E-05,1.23200E-04
3444 DATA 2.41700E-04,3.38800E-04,5.53400E-04,9.11100E-04
3446 DATA 1.40900E-03,2.07800E-03,2.76300E-03,3.79000E-03
3519 REM
3520 REM     LINES 3525-3550 CALC. AVE. STAIN CLASS DIAM., D3(I).
3521 REM
3525 LET D3(1)=.57735*S3(1)
3530 FOR I=2 TO S3
3535 LET S1=(S3(I)^3-(S3(I-1)+1)^3)
3540 LET S2=3*(S3(I)-(S3(I-1)+1))
3545 LET D3(I)=SQR(S1/S2)
3550 NEXT I
3602 REM     LINES  3610-3525  CALC. TOT. NO. OF DROPS, N4
3603 REM
3610 LET N4=0
3615 FOR I=1 TO S3
3620 LET N4=N4+N3(I)
3625 NEXT I
3634 REM
3635 REM     LINES 3645-3655 CALC. % DROPS IN THE ITH. CLASS, P7(I).
3636 REM
```

```
3645 FOR I=1 TO S3
3650 LET P7(I)=100*N3(I)/N4
3655 NEXT I
3660 PRINT
3662 PRINT "SIZE CATE.        % DROPS       STAIN DIAM."
3663 PRINT " I                P7(I)           D3(I)"
3665 PRINT
3670 FOR I=1 TO S3
3675 PRINT I,P7(I),D3(I)
3680 NEXT I
3689 PRINT
3690 PRINT "THE ABOVE RESULTS ARE USE IN FIG. 3"
3691 PRINT
3692 PRINT
3693 PRINT
3704 REM
3705 REM    LINES 3710-3745 CALC. TOT. MASS, M4, & % MASS, M4(I).
3706 REM
3710 LET M4=0
3715 FOR I=1 TO S3
3720 LET M5(I)=N3(I)*M3(I)
3725 LET M4=M4+M5(I)
3730 NEXT I
3735 FOR I=1 TO S3
3740 LET M4(I)=M5(I)/M4
3745 NEXT I
3760 PRINT "SIZE CATE.         MASS           % MASS"
3761 PRINT " I                 M5(I)        100*M4(I)"
3765 PRINT
3770 FOR I=1 TO S3
3775 PRINT I,M5(I),100*M4(I)
3780 NEXT I
3781 PRINT
3782 PRINT "THE ABOVE RESULTS ARE USED IN FIG. 4."
3783 PRINT
3784 PRINT
3785 PRINT
4260 PRINT "TYPE: AIR DEN.,  AIR VISC.,  DROP DEN."
4270 INPUT D2,V1,D1
4280 PRINT
4330 PRINT "TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE."
4340 INPUT C1,U1,Q
4341 PRINT
4342 PRINT
4345 REM
4350 REM    LINE 4365 CONVERTS TAR. DIAM. IN INCHES TO TAR. RAD. IN FT.
4355 REM
4365 LET C2=C1/24
4499 REM
```

Fig. 9g

```
4500 REM      LINES 4535-4690 CALCULATE PROBABILITY OF KILL
4505 REM      FOR EACH SIZE CLASS.  THEY ALSO CALCULATE THE TOT.
4510 REM      PROB. OF KILL, T.  FOR EACH SIZE CLASS, VALUES OF
4520 REM      X  AND  Y  ARE CALCULATED. THESE VALUES ARE
4525 REM      THEN USED IN THE IMPACT EFFICIENCY SUBROUTINE
4530 REM      TO CALCULATE THE IMPACT EFFICIENCY.
4531 REM
4535 LET T=0
4540 FOR Z=1 TO S3
4545 LET R3(Z)=A+B*F*D3(Z)+C*F*(D3(Z)^2)
4550 LET X=(3.50824E-12)*D1*((R3(Z)/2)^2)*U1/(V1*C2)
4570 LET Y=26.4*(D2^2)*C2*U1/(V1*D1)
4590 GOSUB 8205
4624 REM
4625 REM         LINES 4630-4670 CALCULATE PROB. OF KILL, P(I).
4626 REM
4629 REM
4630 REM    LINES 4635-4645 ACCOMODATE A VARIABLE LETHAL DOSE DIAMETER.
4631 REM
4635 IF R3(Z)>=L1GO TO 4650
4640 LET N7(Z)=1.78642E+08/(L1^3)
4645 GO TO 4660
4650 LET N7(Z)=1.78642E+08/(R3(Z)^3)
4660 LET A7(Z)=N7(Z)*M4(Z)
4670 LET P(Z)=E*Q*A7(Z)
4672 LET T=T+P(Z)
4674 REM
4675 REM     LINE 4681 DECIDES IF WANT OUTPUT OF LINES 4684-4687.
4676 REM
4681 IF R7=1GO TO 4684
4682 GO TO 4690
4684 PRINT "Z=";Z,"X=";X,"Y=";Y,"R3(";Z;")=";R3(Z)
4686 PRINT "N7(Z)=";N7(Z),"A7(Z)=";A7(Z),"E=";E,"T=";T
4687 PRINT "P(";Z;")=";P(Z)
4688 PRINT
4690 NEXT Z
4691 PRINT
4692 PRINT
4694 REM
4695 REM      LINES 4700-4747 PRINT RESULTS FOR FIGURE 6.
4696 REM
4700 PRINT "THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW."
4706 PRINT
4710 PRINT "WIND VEL. =";U1,"            TARGET DIAM. =";C1;"INCHES"
4715 PRINT
4720 PRINT "SIZE CATE.    DROP DIAM.    PROB. OF KILL"
4721 PRINT "  I              R3(I)           P(I)"
4725 PRINT
4730 FOR I=1 TO S3
4735 PRINT I,R3(I),P(I)
4740 NEXT I
```

Fig. 9h

```
4745 PRINT
4747 PRINT "TOTAL PROB. OF KILL =";T
4748 PRINT "THE VALUES OF  A,  B,  C  &  F  ARE:";A;B;C;F
4750 PRINT
4751 PRINT
4753 PRINT "THE MINIMUM LETHAL DOSE DIAM. IS";L1
4754 REM
4755 REM     LINES 4760-4775 ENABLE USER TO STOP OR RUN PROG. AGAIN.
4756 REM
4759 PRINT
4760 PRINT "TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP."
4765 INPUT S
4766 PRINT
4770 IF S=1GO TO 4330
4775 GO TO 9999
8203 REM
8204 REM
8205 REM           LINES 8230-8495 ARE IMPACT EFF. SUBROUTINE.
8210 REM
8215 REM
8220 REM          LINES 8230-8495 ARE IMPACT EFFICIENCY SUBROUTINE.
8225 REM
8230 IF X<X(0)GO TO 8255
8235 IF Y<Y(0)GO TO 8265
8240 IF X>X(10)GO TO 8275
8245 IF Y>Y(5)GO TO 8285
8250 GO TO 8300
8255 PRINT "X < X(0)."
8260 STOP
8265 PRINT "Y < Y(0)."
8270 STOP
8272 REM
8273 REM                IF  X > X(10),  SET IMPACT EFF. = 1.
8274 REM
8275 PRINT "FOR SIZE CLASS NO.";Z;" X=";X;" AND X>X(10), THUS, E=1."
8277 LET E=1
8282 GO TO 8495
8285 PRINT "Y > Y(5)"
8290 STOP
8299 REM
8300 REM            LINES 8310-8335 DETERMINE TABLE ENTRY POINT.
8301 REM
8305 REM
8310 FOR I=0 TO 9
8315 IF X<=X(I+1)GO TO 8325
8320 NEXT I
8325 FOR J=0 TO 4
8330 IF Y<=Y(J+1)GO TO 8345
8335 NEXT J
8344 REM
```

Fig. 9i

```
8345 REM                IF X<=0.1 ASSUME IMP. EFF, IS ZERO
8346 REM
8355 IF X>.1GO TO 8385
8360 LET E=0
8365 GO TO 8495
8370 REM
8375 REM      IF 0.1<X<=0.25,  USE EXPO. INTERP. TO CALC IMP EFF.
8380 REM
8385 IF X<.25GO TO 8470
8390 IF Y<5GO TO 8435
8394 REM
8399 REM
8400 REM                BOTH  X>0.25  &  Y>5,  THUS USE LOG. INTERP.
8401 REM
8405 REM
8410 LET A1=(LOG(X)-LOG(X(I)))/(LOG(X(I+1))-LOG(X(I)))
8415 LET B1=(LOG(Y)-LOG(Y(J)+1))/(LOG(Y(J+1))-LOG(Y(J)+1))
8420 GO TO 8480
8429 REM
8430 REM             BOTH X>0.25 & Y<5,  THUS, SET B1=0.
8431 REM
8435 REM
8440 LET A1=(LOG(X)-LOG(X(I)))/(LOG(X(I+1))-LOG(X(I)))
8445 LET B1=0
8450 GO TO 8480
8459 REM
8460 REM          HERE  0.1 < X <= 0.25 & THUS USE EXPON. INTERP.
8461 REM
8470 LET E=.178958*E(I,J)*(EXP(EXP(5*(X-.1)))-2.7128)
8475 GO TO 8495
8480 LET E1=(1-A1)*(1-B1)*E(I,J)+B1*(1-A1)*E(I,J+1)
8485 LET E2=A1*(1-B1)*E(I+1,J)+A1*B1*E(I+1,J+1)
8490 LET E=E1+E2
8495 RETURN
9461 REM
9999 END
```

Fig. 9j

```
10 REM              MINIMUM DROP SIZE CALCULATION
15 REM
20 REM
25 REM
50 REM                     PROGRAM NOTATION
55 REM
60 REM
80 REM        T  =  FORMAT STYLE SWITCH
85 REM
90 REM        W  =  INSECT BODY WEIGHT IN MG.
95 REM
100 REM       D  =  DOSE IN MICRO-GM/(GM BODY WT.)
105 REM
110 REM       C  =  %  INSECTICIDE SPRAY CONC. BY SPRAY VOLUME
115 REM
120 REM      D1  =  SPRAY DENSITY IN GM/(CM^3)
125 REM
130 REM      L1  =  INSECT BODY LENGTH IN CM
135 REM
140 REM      L2  =  INSECT BODY WIDTH IN MM
145 REM
150 REM      D2  =  REQUIRED MINIMUM DROP SIZE DIAMETER IN MICRONS
155 REM
160 REM
500 PRINT "TYPE  1  IF DOSE IN OZ/ACRE; TYPE  0  IF DOSE IN MIC GM/GM WT
"
505 INPUT T
507 PRINT
510 IF T=1GO TO 700
512 PRINT
515 PRINT "TYPE:  THE INSECT BODY WEIGHT  W  &  THE DOSE  D."
520 INPUT W,D
522 PRINT
525 PRINT "TYPE:  THE CONC. BY VOL.  C  &  THE SPRAY DENS.  D1."
530 INPUT C,D1
532 PRINT
550 LET D2=57.5884*((D*W/(C*D1))^(1/3))
555 PRINT
560 PRINT "THE MINIMUM DROP DIAMETER IS  ";D2;" MICRONS."
570 GO TO 800
695 PRINT
700 PRINT "TYPE:  THE LENGTH  L1  &  THE WIDTH  L2  OF THE INSECT."
705 INPUT L1,L2
707 PRINT
710 PRINT "TYPE:  THE DOSE  D, THE CONC.  C  &  THE SPRAY DENS.  D1."
715 INPUT D,C,D1
717 PRINT
720 LET D2=237.4*((L1*L2*D/(C*D1))^(1/3))
725 PRINT
740 PRINT "THE MINIMUM DROP DIAMETER IS ";D2;" MICRONS."
800 END
```

Fig. 10

```
RUN

MDS

TYPE  1  IF DOSE IN OZ/ACRE, TYPE  0  IF DOSE IN MIC GM/GM WT
?1

TYPE:THE LENGTH  L1  &  THE WIDTH  L2  OF THE INSECT.
?2. ,   3

TYPE:  THE DOSE  D, THE CONC.   C  &  THE SPRAY DENS.   D1.
?.64,   2,   1.1

THE MINIMUM DROP DIAMETER IS  285.836 MICRONS.

READY
```

```
RUN

MDS

TYPE  1  IF DOSE IN OZ/ACRE, TYPE  0  IF DOSE IN MIC GM/GM WT
?0

TYPE:  THE INSECT BODY WEIGHT  W  &  THE DOSE  D.
?70,   2.8

TYPE:  THE CONC. BY VOL.   C  &  THE SPRAY DENS.   D1.
?2,   1.1

THE MINIMUM DROP DIAMETER IS  257.205  MICRONS.

READY
```

Typical Results from Minimum Drop Size Calculation Program

Fig. 10a

```
RUN

MDS

TYPE  1  IF DOSE IN OZ/ACRE; TYPE  0  IF DOSE IN MIC GM/GM WT
?1

TYPE:THE LENGTH  L1  &  THE WIDTH  L2  OF THE INSECT.
?.5,   1

TYPE:  THE DOSE  D, THE CONC.   C  &  THE SPRAY DENS.   D1.
?.64,   2,   1.1


THE MINIMUM DROP DIAMETER IS  124.85 MICRONS.

READY
```

```
RUN

MDS

TYPE  1  IF DOSE IN OZ/ACRE; TYPE  0  IF DOSE IN MIC GM/GM WT
?0


TYPE:  THE INSECT BODY WEIGHT  W  &  THE DOSE  D.
?10,   2.8

TYPE:  THE CONC. BY VOL.  C  &  THE SPRAY DENS.  D1.
?2,   1.1


THE MINIMUM DROP DIAMETER IS  134.456  MICRONS.

READY
```

Typical Results from Minimum Drop Size Calculation Program

Fig. 10b

Index of Optimal Drop Size Program Runs and Results

For all runs the following variables were held constant:

a. Air density, D2 = 0.07421 $lbs./ft.^3$

b. Air Viscosity, V1 = 12.43×10^{-6} lbs./ft.sec.

c. Spray density, D1 = 62.428 $lbs./ft.^3$

Run #	Input Format	LD_{90} Rad. L1(Microns)	Tar. Diam. C2(Inches)	Air Vel. U1 (mph)	No. gal./Acre Q
1	ASCAS	0	.03937	1	1
2	ASCAS	0	.03937	6	1
3	ASCAS	0	.03937	1	10
4	Cum. Freq.	0	.03937	1	1
5	Cum. Freq.	0	.03937	6	1
6	Cum. Freq.	0	.03937	1	10
7	ASCAS	0	.11811	1	1
7a	Same as 7 but with lines 4684-4687 printed				
8	ASCAS	0	.11811	6	1
9	ASCAS	0	.11811	1	10
10	Cum. Freq.	0	.11811	1	1
10a	Same as 10 but with lines 4684-4687 printed				
11	Cum. Freq.	0	.11811	6	1
12	ASCAS	134.5	.03937	1	1
13	ASCAS	134.5	.03937	6	1
14	ASCAS	257.2	.11811	1	1
15	ASCAS	257.2	.11811	6	1
16	ASCAS	124.8	.03937	1	1
17	ASCAS	285.8	.11811	1	1
18	Cum. Freq.	134.5	.03937	1	1
19	Cum. Freq.	124.8	.03937	1	1
20	Cum. Freq.	257.2	.11811	1	1
21	Cum. Freq.	285.8	.11811	1	1

```
TYPE  1  IF WANT LINES  4684-4687  PRINTED; ELSE TYPE  0
?0

TYPE MINIMUM LETHAL DOSE, L1; IF NO MIN. L.D., TYPE 0
?0

TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0.
?0

TYPE:  NO. OF SIZE CLASSES, S3
?16

TYPE PHOTO-REDUCTION FACTOR, F
?1

TYPE THE MAGNIFICATION FACTORS  A,  B  &  C
?0,   .5556,   0
```

SIZE CATE. I	% DROPS P7(I)	STAIN DIAM. D3(I)
1	23.6235	58.8897
2	8.13623	141.62
3	24.3105	262.102
4	22.5832	423.125
5	13.2202	585.348
6	5.73166	750.051
7	1.71753	916.738
8	.598665	1107.21
9	.0785015	1332.23
10	0	1551.1
11	0	1826.7
12	0	2156.93
13	0	2494.63
14	0	2839.11
15	0	3122.24
16	0	3468.97

THE ABOVE RESULTS ARE USED IN FIG. 3

SIZE CATE. I	MASS M5(I)	% MASS 100*M4(I)
1	.0108349	.0502963
2	.0519093	.240966
3	.983294	4.5645
4	3.84254	17.8373
5	5.95549	27.6457
6	5.43205	25.2159
7	2.97211	13.7967
8	1.82459	8.46985
9	.469381	2.17889
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0

THE ABOVE RESULTS ARE USED IN FIG. 4

```
TYPE:  AIR DEN.,  AIR VISC.,  DROP DEN.
?.07421,   12.43E-6,   62.428

TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE
?.03937,   1,  1


FOR SIZE CLASS NO. 6 X= 466.326  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 7 X= 696.624  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 8 X= 1016.17  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 9 X= 1471.18  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 10 X= 1994.28  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 11 X= 2765.94  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 12 X= 3856.38  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 13 X= 5158.46  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 14 X= 6681.47  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 15 X= 8080.52  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 16 X= 9974.88  AND  X>X(10).  THUS,  E=1
```

Run 1 (continued)

```
THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW

WIND VEL. = 1                  TARGET DIAM. = .03937 INCHES

SIZE CATE.     DROP DIAM.     PROB. OF KILL
  I              R3(I)           P(I)

 1              32.7191        1.69172
 2              78.6843        .814315
 3              145.624        2.55033
 4              235.088        2.416
 5              325.219        1.42637
 6              416.728        .622441
 7              509.34         .186524
 8              615.165        .0649956
 9              740.186        9.59835E-03
 10             861.789        0
 11             1014.92        0
 12             1198.39        0
 13             1386.02        0
 14             1577.41        0
 15             1734.71        0
 16             1927.36        0

TOTAL PROB. OF KILL = 9.78231

THE VALUES OF  A,  B,  C  &  F  ARE 0  .5556  0  1

THE MINIMUM LETHAL DOSE DIAM. IS 0

TYPE  1  TO RUN PROG. AGAIN;  TYPE  0  TO STOP
?1
```

```
TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE
?.03937,   1,   10


FOR SIZE CLASS NO. 6 X= 466.326  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 7 X= 696.624  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 8 X= 1016.17  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 9 X= 1471.18  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 10 X= 1994.28  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 11 X= 2765.94  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 12 X= 3856.38  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 13 X= 5158.46  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 14 X= 6681.47  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 15 X= 8080.52  AND  X>X(10),  THUS,  E=1
FOR SIZE CLASS NO. 16 X= 9974.88  AND  X>X(10),  THUS,  E=1


THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW

WIND VEL. = 1                TARGET DIAM. = .03937 INCHES

SIZE CATE.     DROP DIAM.     PROB. OF KILL
  I.             R3(I)           P(I)

 1              32.7191        16.9172
 2              78.6843        8.14315
 3              145.624        25.5033
 4              235.088        24.16
 5              325.219        14.2637
 6              416.728        6.22441
 7              509.34         1.86524
 8              615.165        .649956
 9              740.186        .0959835
 10             861.789        0
 11             1014.92        0
 12             1198.39        0
 13             1386.02        0
 14             1577.41        0
 15             1734.71        0
 16             1927.36        0

TOTAL PROB. OF KILL = 97.8231

THE VALUES OF  A,  B,  C  &  F  ARE 0  .5556  0  1

THE MINIMUM LETHAL DOSE DIAM. IS 0

TYPE  1  TO RUN PROG. AGAIN;  TYPE  0  TO STOP
?1
```

Run 2

```
TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE.
?.03937,   1,   10


FOR SIZE CLASS NO. 6  X= 466.326  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 7  X= 696.624  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 8  X= 1016.17  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 9  X= 1471.18  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 10  X= 1994.28  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 11  X= 2765.94  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 12  X= 3856.38  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13  X= 5158.46  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14  X= 6681.47  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15  X= 8080.52  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16  X= 9974.88  AND X>X(10), THUS, E=1.


THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL. = 1            TARGET DIAM. = .03937 INCHES

SIZE CATE.     DROP DIAM.     PROB. OF KILL
  I              R3(I)           P(I)

 1              32.7191        16.9172
 2              78.6843        8.14315
 3              145.624        25.5033
 4              235.088        24.16
 5              325.219        14.2637
 6              416.728        6.22441
 7              509.34         1.86524
 8              615.165        .649956
 9              740.186        .0959835
 10             861.789        0
 11             1014.92        0
 12             1198.39        0
 13             1386.02        0
 14             1577.41        0
 15             1734.71        0
 16             1927.36        0

TOTAL PROB. OF KILL = 97.8231
THE VALUES OF  A,  B,  C  &  F  ARE: 0  .5556  0  1


THE MINIMUM LETHAL DOSE DIAM. IS 0

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP.
?1
```

TYPE 1 IF WANT LINES 4684-4687 PRINTED; ELSE TYPE 0.
?0

TYPE MINIMUM LETHAL DOSE, L1; IF NO MIN. L.D., TYPE 0.
?0

TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0.
?1

TYPE: NO. OF SIZE CLASSES, S3.
?16

CALCULATIONS BASED UPON CUM. FREQ. VS. DIAM. FORMAT.

SIZE CATE. I	BDY. DIAM. S3(I)	AVE. DIAM. D3(I)	% DROPS P3(I)	% MASS 100*M4(I)
1	21.4	12.3553	19.18	.0197307
2	34.1	27.9911	11.06	.132297
3	61.5	48.45	20.06	1.24436
4	89.4	75.8786	15.02	3.57901
5	116.9	103.455	11.47	6.92712
6	145.5	131.46	7.49001	9.28096
7	173.7	159.807	5.55	12.3543
8	210.1	192.187	5.32	20.5978
9	250.2	230.441	3.23	21.5584
10	284.7	267.635	.900002	9.41041
11	343.4	314.507	.559998	9.50192
12	397.2	370.626	.110001	3.05447
13	458.1	428.011	.0400009	1.71069
14	514.5	486.572	.0100021	.628449
15	554.7	534.726	0	0
16	631.8	593.667	0	0

THE ABOVE RESULTS ARE USED IN FIGS. 3 & 4.

TYPE: AIR DEN., AIR VISC., DROP DEN.
?.07421, 12.43E-06, 62.428

TYPE: TAR. DIAM. (INCHES), AIR VEL., NO. OF GAL./ACRE.
?.03937, 1, 1

```
FOR SIZE CLASS NO.  12   X= 368.854   AND X>X(10),  THUS,  E=1.
FOR SIZE CLASS NO.  13   X= 491.919   AND X>X(10),  THUS,  E=1.
FOR SIZE CLASS NO.  14   X= 635.738   AND X>X(10),  THUS,  E=1.
FOR SIZE CLASS NO.  15   X= 767.796   AND X>X(10),  THUS,  E=1.
FOR SIZE CLASS NO.  16   X= 946.389   AND X>X(10),  THUS,  E=1.


THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL.  = 1              TARGET DIAM.  = .03937 INCHES

SIZE CATE.     DROP DIAM.     PROB.  OF KILL
  I              R3(I)           P(I)

 1              12.3553        3.00619
 2              27.9911        6.27718
 3              48.45          16.0735
 4              75.8786        13.4242
 5              103.455        10.5461
 6              131.46         7.01134
 7              159.807        5.24832
 8              192.187        5.07884
 9              230.441        3.09864
 10             267.635        .866782
 11             314.507        .541599
 12             370.626        .10718
 13             428.011        .0389752
 14             486.572        9.74566E-03
 15             534.726        0
 16             593.667        0

TOTAL PROB.  OF KILL = 71.3286
THE VALUES OF  A,  B,  C  &  F  ARE: 0  1  0  1


THE MINIMUM LETHAL DOSE DIAM.  IS 0

TYPE 1 TO RUN PROG.  AGAIN; ELSE TYPE 0 TO STOP.
?1
```

Run 4 (continued)

```
TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE.
?.03937,   6,   1


FOR SIZE CLASS NO. 7  X= 411.461  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 8  X= 595.093  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 9  X= 855.567  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 10  X= 1154.04  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 11  X= 1593.66  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 12  X= 2213.12  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13  X= 2951.51  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14  X= 3814.43  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15  X= 4606.78  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16  X= 5678.33  AND X>X(10), THUS, E=1.


THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL. = 6            TARGET DIAM. = .03937 INCHES

SIZE CATE.     DROP DIAM.     PROB. OF KILL
  I              R3(I)           P(I)

 1              12.3553        11.6057
 2              27.9911        9.71159
 3              48.45          18.6609
 4              75.8786        14.3146
 5              103.455        11.0309
 6              131.46         7.24836
 7              159.807        5.40768
 8              192.187        5.18358
 9              230.441        3.14718
 10             267.635        .876923
 11             314.507        .545638
 12             370.626        .10718
 13             428.011        .0389752
 14             486.572        9.74566E-03
 15             534.726        0
 16             593.667        0

TOTAL PROB. OF KILL = 87.8889
THE VALUES OF  A,  B,  C  &  F  ARE: 0  1  0  1


THE MINIMUM LETHAL DOSE DIAM. IS 0

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP.
?1
```

```
TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE.
?.03937,   1,   10


FOR SIZE CLASS NO. 12  X= 368.854  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13  X= 491.919  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14  X= 635.738  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15  X= 767.796  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16  X= 946.389  AND X>X(10), THUS, E=1.


THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL. = 1             TARGET DIAM. = .03937 INCHES

SIZE CATE.     DROP DIAM.     PROB. OF KILL
  I              R3(I)           P(I)

 1              12.3553        30.0619
 2              27.9911        62.7718
 3              48.45          160.735
 4              75.6786        134.242
 5              103.455        105.461
 6              131.46         70.1134
 7              159.807        52.4832
 8              192.187        50.7884
 9              230.441        30.9864
 10             267.635        8.66782
 11             314.507        5.41599
 12             370.626        1.0718
 13             428.011        .389752
 14             486.572        .0974566
 15             534.726        0
 16             593.667        0

TOTAL PROB. OF KILL = 713.287
 THE VALUES OF  A,  B,  C  &  F  ARE: 0  1  0  1


 THE MINIMUM LETHAL DOSE DIAM. IS 0

 TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP.
 ?0
```

```
TYPE  1  IF WANT LINES 4684-4687 PRINTED, ELSE TYPE 0.
?0


TYPE MINIMUM LETHAL DOSE, L1; IF NO MIN. L.D., TYPE 0.
?0


TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0.
?0

TYPE   NO. OF SIZE CLASSES, S3.
?16

TYPE PHOTO-REDUCTION FACTOR, F.
?1

TYPE THE MAGNIFICATION FACTORS A, B & C.
?0,   .5556,   0
```

SIZE CATE. I	% DROPS P7(I)	STAIN DIAM. D3(I)
1	23.6235	58.8897
2	8.13623	141.62
3	24.3105	262.102
4	22.5832	423.125
5	13.2202	585.348
6	5.73166	750.051
7	1.71753	916.738
8	.598665	1107.21
9	.0785015	1332.23
10	0	1551.1
11	0	1826.7
12	0	2156.93
13	0	2494.63
14	0	2839.11
15	0	3122.24
16	0	3468.97

THE ABOVE RESULTS ARE USE IN FIG. 3

SIZE CATE. I	MASS M5(I)	% MASS 100*M4(I)
1	.0108349	.0502963
2	.0519093	.240966
3	.983294	4.5645
4	3.84254	17.8373
5	5.95549	27.6457
6	5.43205	25.2159
7	2.97211	13.7967
8	1.82459	8.46985
9	.469381	2.17889
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0

THE ABOVE RESULTS ARE USED IN FIG. 4.

```
TYPE: AIR DEN.,  AIR VISC.,  DROP DEN.
?.07421,   12.43E-06,   62.428


TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE.
?.11811,   1,   1


FOR SIZE CLASS NO. 8  X= 338.724  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 9  X= 490.393  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 10  X= 664.759  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 11  X= 921.98  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 12  X= 1285.46  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13  X= 1719.49  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO  14  X= 2227.16  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15  X= 2693.51  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16  X= 3324.96  AND X>X(10), THUS, E=1.
```

THE DATA FOR FIGURE 6 OR 7 APPEARS BELOW.

WIND VEL. = 1 TARGET DIAM. = .11811 INCHES

SIZE CATE. I	DROP DIAM. R3(I)	PROB OF KILL P(I)
1	32.7191	.947122
2	78.6843	.706309
3	145.624	2.44745
4	235.088	2.36018
5	325.219	1.40507
6	416.728	.613533
7	509.34	.18482
8	615.165	.0649956
9	740.186	9.59835E-03
10	861.789	0
11	1014.92	0
12	1198.39	0
13	1386.02	0
14	1577.41	0
15	1734.71	0
16	1927.36	0

TOTAL PROB. OF KILL = 8.73908
THE VALUES OF A, B, C & F ARE: 0 .5556 0 1

THE MINIMUM LETHAL DOSE DIAM. IS 0

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP.
?1

Run 7 (continued)

```
TYPE  1  IF WANT LINES 4684-4687 PRINTED; ELSE TYPE 0.
?1


TYPE MINIMUM LETHAL DOSE, L1; IF NO MIN. L.D., TYPE 0.
?0


TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0.
?0

TYPE:  NO. OF SIZE CLASSES, S3.
?16

TYPE PHOTO-REDUCTION FACTOR, F.
?1

TYPE THE MAGNIFICATION FACTORS A, B & C.
?0,   .5556,   0
```

SIZE CATE. I	% DROPS P7(I)	STAIN DIAM. D3(I)
1	23.6235	58.8897
2	8.13623	141.62
3	24.3105	262.102
4	22.5832	423.125
5	13.2202	585.348
6	5.73166	750.051
7	1.71753	916.738
8	.598665	1107.21
9	.0785015	1332.23
10	0	1551.1
11	0	1826.7
12	0	2156.93
13	0	2494.63
14	0	2839.11
15	0	3122.24
16	0	3468.97

THE ABOVE RESULTS ARE USE IN FIG. 3

SIZE CATE. I	MASS M5(I)	% MASS 100*M4(I)
1	.0108349	.0502963
2	.0519093	.240966
3	.983294	4.5645
4	3.84254	17.8373
5	5.95549	27.6457
6	5.43205	25.2159
7	2.97211	13.7967
8	1.82459	8.46985
9	.469381	2.17889
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0

THE ABOVE RESULTS ARE USED IN FIG. 4.

```
TYPE: AIR DEN., AIR VISC., DROP DEN.
? 07421,   12.43E-06,   62.428

TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE.
?.11811,   1,   1


Z= 1          X= .95822     Y= .922048    R3( 1 )= 32.7191
N7(Z)= 5100.1 A7(Z)= 2.56516              E= .369225    T= .947122
P( 1 )= .947122

Z= 2          X= 5.54164    Y= .922048    R3( 2 )= 78.6843
N7(Z)= 366.707              A7(Z)= .883639              E= .799319
T= 1.65343
P( 2 )= .706309

Z= 3          X= 18.9813    Y= .922048    R3( 3 )= 145.624
N7(Z)= 57.8478              A7(Z)= 2.64046              E= .9269
T= 4.10088
P( 3 )= 2.44745

Z= 4          X= 49.4678    Y= .922048    R3( 4 )= 235.088
N7(Z)= 13.7497              A7(Z)= 2.45257              E= .962332
T= 6.46106
P( 4 )= 2.36018
```

```
Z= 5             X= 94.6706     Y= .922048     R3( 5 )= 325.219
N7(Z)= 5.19343                  A7(Z)= 1.43576                       E= .978625
T= 7.86613
P( 5 )= 1.40507

Z= 6             X= 155.442     Y= .922048     R3( 6 )= 416.728
N7(Z)= 2.46845                  A7(Z)= .622441                       E= .985688
T= 8.47966
P( 6 )= .613533

Z= 7             X= 232.208     Y= .922048     R3( 7 )= 509.34
N7(Z)= 1.35195                  A7(Z)= .186524                       E= .990864
T= 8.66449
P( 7 )= .18482

FOR SIZE CLASS NO.  8  X= 338.724  AND X>X(10), THUS, E=1.
Z= 8             X= 338.724     Y= .922048     R3( 8 )= 615.165
N7(Z)= .767376                  A7(Z)= .0649956                      E= 1
T= 8.72948
P( 8 )= .0649956

FOR SIZE CLASS NO.  9  X= 490.393  AND X>X(10), THUS, E=1.
Z= 9             X= 490.393     Y= .922048     R3( 9 )= 740.186
N7(Z)= .440515                  A7(Z)= 9.59835E-03                   E= 1
T= 8.73908
P( 9 )= 9.59835E-03

FOR SIZE CLASS NO.  10  X= 664.759  AND X>X(10), THUS, E=1.
Z= 10            X= 664.759     Y= .922048     R3( 10 )= 861.789
N7(Z)= .279113                  A7(Z)= 0       E= 1           T= 8.73908
P( 10 )= 0

FOR SIZE CLASS NO.  11  X= 921.98  AND X>X(10), THUS, E=1.
Z= 11            X= 921.98      Y= .922048     R3( 11 )= 1014.92
N7(Z)= .170881                  A7(Z)= 0       E= 1           T= 8.73908
P( 11 )= 0

FOR SIZE CLASS NO.  12  X= 1285.46  AND X>X(10), THUS, E=1.
Z= 12            X= 1285.46     Y= .922048     R3( 12 )= 1198.39
N7(Z)= .103798                  A7(Z)= 0       E= 1           T= 8.73908
P( 12 )= 0

FOR SIZE CLASS NO.  13  X= 1719.49  AND X>X(10), THUS, E=1.
Z= 13            X= 1719.49     Y= .922048     R3( 13 )= 1386.02
N7(Z)= .0670932                 A7(Z)= 0       E= 1           T= 8.73908
P( 13 )= 0

FOR SIZE CLASS NO.  14  X= 2227.16  AND X>X(10), THUS, E=1.
Z= 14            X= 2227.16     Y= .922048     R3( 14 )= 1577.41
N7(Z)= .0455146                 A7(Z)= 0       E= 1           T= 8.73908
P( 14 )= 0
```

```
FOR SIZE CLASS NO.  15   X= 2693.51   AND X>X(10),  THUS, E=1.
Z= 15            X= 2693.51     Y= .922048     R3( 15 )= 1734.71
N7(Z)= .0342215                 A7(Z)= 0       E= 1            T= 8.73908
P( 15 )= 0

FOR SIZE CLASS NO.  16   X= 3324.96   AND X>X(10),  THUS, E=1.
Z= 16            X= 3324.96     Y= .922048     R3( 16 )= 1927.36
N7(Z)= .0249515                 A7(Z)= 0       E= 1            T= 8.73908
P( 16 )= 0


THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL.  = 1                TARGET DIAM.  = .11811 INCHES

SIZE CATE.     DROP DIAM.     PROB.  OF KILL
  I              R3(I)           P(I)

 1               32.7191        .947122
 2               78.6843        .706309
 3               145.624        2.44745
 4               235.088        2.36018
 5               325.219        1.40507
 6               416.728        .613533
 7               509.34         .18482
 8               615.165        .0649956
 9               740.186        9.59835E-03
 10              861.789        0
 11              1014.92        0
 12              1198.39        0
 13              1386.02        0
 14              1577.41        0
 15              1734.71        0
 16              1927.36        0

 TOTAL PROB.  OF KILL = 8.73908
 THE VALUES OF  A,  B,  C  &  F  ARE: 0  .5556  0  1


 THE MINIMUM LETHAL DOSE DIAM.  IS 0

 TYPE 1 TO RUN PROG.  AGAIN; ELSE TYPE 0 TO STOP.
 ?1
```

```
TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE.
? .11811,   6,   1

FOR SIZE CLASS NO.  5  X= 568.023  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO.  6  X= 932.651  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO.  7  X= 1393.25  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO.  8  X= 2032.34  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO.  9  X= 2942.36  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO  10  X= 3988.55  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 11  X= 5531.88  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 12  X= 7712.76  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13  X= 10316.9  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14  X= 13362.9  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15  X= 16161.1  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16  X= 19949.8  AND X>X(10), THUS, E=1.

THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL. = 6            TARGET DIAM. = .11811 INCHES

SIZE CATE.     DROP DIAM.     PROB. OF KILL
  I              R3(I)           P(I)

 1             32.7191        2.06201
 2             78.6843        .827091
 3             145.624        2.57356
 4             235.088        2.42822
 5             325.219        1.43576
 6             416.728        .622441
 7             509.34         .186524
 8             615.165        .0649956
 9             740.186        9.59835E-03
 10            861.789        0
 11            1014.92        0
 12            1198.39        0
 13            1386.02        0
 14            1577.41        0
 15            1734.71        0
 16            1927.36        0

TOTAL PROB. OF KILL = 10.2102
THE VALUES OF  A, B, C & F  ARE: 0  .5556  0  1

THE MINIMUM LETHAL DOSE DIAM. IS 0

TYPE 1 TO RUN PROG. AGAIN, ELSE TYPE 0 TO STOP.
?1
```

Run 8

```
TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE.
?.11811,   1,   10


FOR SIZE CLASS NO. 8  X= 338.724  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 9  X= 490.393  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 10  X= 664.759  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 11  X= 921.98  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 12  X= 1285.46  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13  X= 1719.49  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14  X= 2227.16  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15  X= 2693.51  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16  X= 3324.96  AND X>X(10), THUS, E=1.


THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL. = 1              TARGET DIAM. = .11811 INCHES

SIZE CATE.     DROP DIAM.     PROB. OF KILL
  I              R3(I)           P(I)

 1              32.7191        9.47122
 2              78.6843        7.06309
 3              145.624        24.4745
 4              235.088        23.6018
 5              325.219        14.0507
 6              416.728        6.13533
 7              509.34         1.8482
 8              615.165        .649956
 9              740.186        .0959835
 10             861.789        0
 11             1014.92        0
 12             1198.39        0
 13             1386.02        0
 14             1577.41        0
 15             1734.71        0
 16             1927.36        0

TOTAL PROB. OF KILL = 87.3908
THE VALUES OF  A,  B,  C  &  F  ARE: 0  .5556  0  1


THE MINIMUM LETHAL DOSE DIAM. IS 0

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP
?
```

```
TYPE  1  IF WANT LINES 4684-4687 PRINTED; ELSE TYPE 0.
?0


TYPE MINIMUM LETHAL DOSE, L1; IF NO MIN. L.D., TYPE 0.
?0


TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0
?1

TYPE:  NO. OF SIZE CLASSES, S3.
?16


      CALCULATIONS BASED UPON CUM. FREQ. VS. DIAM. FORMAT.
```

SIZE CATE. I	BDY. DIAM. S3(I)	AVE. DIAM. D3(I)	% DROPS P3(I)	% MASS 100*M4(I)
1	21.4	12.3553	19.18	.0197307
2	34.1	27.9911	11.06	.132297
3	61.5	48.45	20.06	1.24436
4	89.4	75.8786	15.02	3.57901
5	116.9	103.455	11.47	6.92712
6	145.5	131.46	7.49001	9.28096
7	173.7	159.807	5.55	12.3543
8	210.1	192.187	5.32	20.5978
9	250.2	230.441	3.23	21.5584
10	284.7	267.635	.900002	9.41041
11	343.4	314.507	.559998	9.50192
12	397.2	370.626	.110001	3.05447
13	458.1	428.011	.0400009	1.71069
14	514.5	486.572	.0100021	.628449
15	554.7	534.726	0	0
16	631.8	593.667	0	0

```
THE ABOVE RESULTS ARE USED IN FIGS. 3 & 4.


TYPE: AIR DEN.,  AIR VISC.,  DROP DEN.
?.07421,   12.43E-06,   62.428

TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE.
?.11811,   1,   1
```

```
THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL.  = 1              TARGET DIAM.  =  11811 INCHES

SIZE CATE.     DROP DIAM.     PROB. OF KILL
  I              R3(I)            P(I)

 1               12.3553        0
 2               27.9911        3.12965
 3               48.45          11.3788
 4               75.8786        11.5078
 5               103.455        9.82696
 6               131.46         6.69454
 7               159.807        5.05297
 8               192.187        4.92081
 9               230.441        3.02548
 10              267.635        .8496
 11              314.507        .533058
 12              370.626        .105322
 13              428.011        .0394443
 14              486.572        9.64513E-03
 15              534.726        0
 16              593.667        0

TOTAL PROB. OF KILL = 57.0731
THE VALUES OF  A,  B,  C  &  F  ARE: 0  1  0  1

THE MINIMUM LETHAL DOSE DIAM. IS 0

TYPE 1 TO RUN PROG. AGAIN, ELSE TYPE 0 TO STOP.
?1
```

Run 10 (continued)

TYPE 1 IF WANT LINES 4684-4687 PRINTED; ELSE TYPE 0.
?1

TYPE MINIMUM LETHAL DOSE, L1; IF NO MIN L.D., TYPE 0
?0

TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0.
?1

TYPE: NO. OF SIZE CLASSES, S3.
?16

CALCULATIONS BASED UPON CUM. FREQ. VS. DIAM. FORMAT.

SIZE CATE. I	BDY. DIAM. S3(I)	AVE. DIAM. D3(I)	% DROPS P3(I)	% MASS 100*M4(I)
1	21.4	12.3553	19.18	.0197307
2	34.1	27.9911	11.06	.132297
3	61.5	48.45	20.06	1.24436
4	89.4	75.8786	15.02	3.57901
5	116.9	103.455	11.47	6.92712
6	145.5	131.46	7.49001	9.28096
7	173.7	159.807	5.55	12.3543
8	210.1	192.187	5.32	20.5978
9	250.2	230.441	3.23	21.5584
10	284.7	267.635	.900002	9.41041
11	343.4	314.507	.559998	9.50192
12	397.2	370.626	.110001	3.05447
13	458.1	428.011	.0400009	1.71069
14	514.5	486.572	.0100021	.628449
15	554.7	534.726	0	0
16	631.8	593.667	0	0

THE ABOVE RESULTS ARE USED IN FIGS. 3 & 4.

TYPE: AIR DEN., AIR VISC., DROP DEN.
?.07421, 12.43E-06, 62.428

TYPE: TAR. DIAM. (INCHES), AIR VEL., NO. OF GAL./ACRE.
?.11811, 6, 1

```
Z= 1          X= .819821    Y= 5.53229    R3( 1 )= 12.3553
N7(Z)= 94716.3              A7(Z)= 18.6882            E= .305917
T= 5.71704
P( 1 )= 5.71704

Z= 2          X= 4.20779    Y= 5.53229    R3( 2 )= 27.9911
N7(Z)= 8145.59              A7(Z)= 10.7764            E= .730278
T= 13.5868
P( 2 )= 7.86976

Z= 3          X= 12.6067    Y= 5.53229    R3( 3 )= 48.45
N7(Z)= 1570.73              A7(Z)= 19.5456            E= .894649
T= 31.0733
P( 3 )= 17.4865

Z= 4          X= 30.9209    Y= 5.53229    R3( 4 )= 75.8786
N7(Z)= 408.907              A7(Z)= 14.6349            E= .932572
T= 44.7213
P( 4 )= 13.6481

Z= 5          X= 57.48      Y= 5.53229    R3( 5 )= 103.455
N7(Z)= 161.335              A7(Z)= 11.1759            E= .955753
T= 55.4027
P( 5 )= 10.6814

Z= 6          X= 92.8106    Y= 5.53229    R3( 6 )= 131.46
N7(Z)= 78.6335              A7(Z)= 7.29794            E= .970305
T= 62.4839
P( 6 )= 7.08123

Z= 7          X= 137.154    Y= 5.53229    R3( 7 )= 159.807
N7(Z)= 43.7716              A7(Z)= 5.40768            E= .977654
T= 67.7708
P( 7 )= 5.28684

Z= 8          X= 198.364    Y= 5.53229    R3( 8 )= 192.187
N7(Z)= 25.1657              A7(Z)= 5.18358            E= .983591
T= 72.8693
P( 8 )= 5.09853

Z= 9          X= 285.189    Y= 5.53229    R3( 9 )= 230.441
N7(Z)= 14.5984              A7(Z)= 3.14718            E= .989432
T= 75.9832
P( 9 )= 3.11392

FOR SIZE CLASS NO. 10  X= 384.681  AND X>X(10), THUS, E=1.
Z= 10         X= 384.681    Y= 5.53229    R3( 10 )= 267.635
N7(Z)= 9.31865              A7(Z)= .876923            E= 1
T= 76.8601
P( 10 )= .876923
```

Run 10a (continued)

```
FOR SIZE CLASS NO. 11  X= 531.219  AND X>X(10), THUS, E=1.
Z= 11          X= 531.219    Y= 5.53229    R3( 11 )= 314.507
N7(Z)= 5.7424 A7(Z)= .545638               E= 1            T= 77.4058
P( 11 )= .545638

FOR SIZE CLASS NO. 12  X= 737.707  AND X>X(10), THUS, E=1.
Z= 12          X= 737 707    Y= 5.53229    R3( 12 )= 370.626
N7(Z)= 3.50895               A7(Z)= .10718 E= 1            T= 77.513
P( 12 )= .10718

FOR SIZE CLASS NO. 13  X= 983.838  AND X>X(10), THUS, E=1.
Z= 13          X= 983.838    Y= 5.53229    R3( 13 )= 428.011
N7(Z)= 2.27834               A7(Z)= .0389752               E= 1
T= 77.5519
P( 13 )= .0389752

FOR SIZE CLASS NO. 14  X= 1271.48  AND X>X(10), THUS, E=1.
Z= 14          X= 1271.48    Y= 5.53229    R3( 14 )= 486.572
N7(Z)= 1.55075               A7(Z)= 9.74566E-03            E= 1
T= 77.5617
P( 14 )= 9.74566E-03

FOR SIZE CLASS NO. 15  X= 1535.59  AND X>X(10), THUS, E=1.
Z= 15          X= 1535.59    Y= 5.53229    R3( 15 )= 534.726
N7(Z)= 1.1684 A7(Z)= 0       E= 1          T= 77.5617
P( 15 )= 0

FOR SIZE CLASS NO. 16  X= 1892.78  AND X>X(10), THUS, E=1.
Z= 16          X= 1892.78    Y= 5.53229    R3( 16 )= 593.667
N7(Z)= .853796               A7(Z)= 0      E= 1            T= 77.5617
P( 16 )= 0


THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL. = 6             TARGET DIAM. = .11811 INCHES
```

SIZE CATE. I	DROP DIAM. R3(I)	PROB. OF KILL P(I)
1	12.3553	5.71704
2	27.9911	7.86976
3	48.45	17.4865
4	75.8786	13.6481
5	103.455	10.6814
6	131.46	7.08123
7	159.807	5.28684
8	192.187	5.09853
9	230.441	3.11392
10	267.635	.876923
11	314.507	.545638
12	370.626	.10718
13	428.011	.0389752
14	486.572	9.74566E-03
15	534.726	0
16	593.667	0

TOTAL PROB. OF KILL = 77.5617
THE VALUES OF A, B, C & F ARE: 0 1 0 1

THE MINIMUM LETHAL DOSE DIAM. IS 0

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP.
?0

Run 10a (continued)

```
TYPE: TAR. DIAM. (INCHES), AIR VEL. , NO. OF GAL./ACRE.
? 11811, 6, 1


FOR SIZE CLASS NO. 10  X= 384.681  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 11  X= 531.219  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 12  X= 737.707  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13  X= 983.838  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14  X= 1271.48  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15  X= 1535.59  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16  X= 1892.78  AND X>X(10), THUS, E=1.


THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL. = 6             TARGET DIAM. =  11811 INCHES

SIZE CATE.     DROP DIAM.     PROB. OF KILL
  I               R3(I)           P(I)

 1                12.3553        5.71704
 2                27.9911        7.86976
 3                48.45          17.4865
 4                75.8786        13.6481
 5                103.455        10.6814
 6                131.46         7.08123
 7                159.807        5.28684
 8                192.187        5.09853
 9                230.441        3.11392
 10               267.635        .876923
 11               314.507        .545638
 12               370.626        .10718
 13               428.011        .0389752
 14               486.572        9.74566E-03
 15               534.726        0
 16               593.667        0

TOTAL PROB. OF KILL = 77.5617
THE VALUES OF  A,  B,  C  &  F  ARE  0  1  0  1


THE MINIMUM LETHAL DOSE DIAM. IS 0

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP.
?0
```

TYPE 1 IF WANT LINES 4684-4687 PRINTED; ELSE TYPE 0.
?0

TYPE MINIMUM LETHAL DOSE, L1; IF NO MIN. L.D., TYPE 0.
?134.5

TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0.
?0

TYPE: NO. OF SIZE CLASSES, S3.
?16

TYPE PHOTO-REDUCTION FACTOR, F.
?1

TYPE THE MAGNIFICATION FACTORS A, B & C.
?0, .5556, 0

SIZE CATE. I	% DROPS P7(I)	STAIN DIAM. D3(I)
1	23.6235	58.8897
2	8.13623	141.62
3	24.3105	262.102
4	22.5832	423.125
5	13.2202	585.348
6	5.73166	750.051
7	1.71753	916.738
8	.598665	1107.21
9	.0785015	1332.23
10	0	1551.1
11	0	1826.7
12	0	2156.93
13	0	2494.63
14	0	2839.11
15	0	3122.24
16	0	3468.97

THE ABOVE RESULTS ARE USE IN FIG. 3

SIZE CATE. I	MASS M5(I)	% MASS 100*M4(I)
1	.0108349	.0502963
2	.0519093	.240966
3	.983294	4.5645
4	3.84254	17.8373
5	5.95549	27.6457
6	5.43205	25.2159
7	2.97211	13.7967
8	1.82459	8.46985
9	.469381	2.17889
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0

THE ABOVE RESULTS ARE USED IN FIG. 4.

TYPE: AIR DEN., AIR VISC., DROP DEN.
?.07421, 12.43E-06, 62.428

TYPE: TAR. DIAM. (INCHES), AIR VEL., NO. OF GAL./ACRE.
?.03937, 1, 1

FOR SIZE CLASS NO. 6 X= 466.326 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 7 X= 696.624 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 8 X= 1016.17 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 9 X= 1471.18 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 10 X= 1994.28 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 11 X= 2765.94 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 12 X= 3856.38 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13 X= 5158.46 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14 X= 6681.47 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15 X= 8080.52 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16 X= 9974.88 AND X>X(10), THUS, E=1.

Run 12 (continued)

THE DATA FOR FIGURE 6 OR 7 APPEARS BELOW.

WIND VEL. = 1 TARGET DIAM. = .03937 INCHES

SIZE CATE. I	DROP DIAM. R3(I)	PROB. OF KILL P(I)
1	32.7191	.0243538
2	78.6843	.163038
3	145.624	2.55033
4	235.088	2.416
5	325.219	1.42637
6	416.728	.622441
7	509.34	.186524
8	615.165	.0649956
9	740.186	9.59835E-03
10	861.789	0
11	1014.92	0
12	1198.39	0
13	1386.02	0
14	1577.41	0
15	1734.71	0
16	1927.36	0

TOTAL PROB. OF KILL = 7.46366
THE VALUES OF A, B, C & F ARE: 0 .5556 0 1

THE MINIMUM LETHAL DOSE DIAM. IS 134.5

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP.
?1

```
TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE.
? 03937,   6,   1


FOR SIZE CLASS NO. 3  X= 341.664  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 4  X= 890.421  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 5  X= 1704.07  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 6  X= 2797.95  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 7  X= 4179.75  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 8  X= 6097.03  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 9  X= 8827.07  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 10  X= 11965.7  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 11  X= 16595.6  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 12  X= 23138.3  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13  X= 30950.8  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14  X= 40088.8  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15  X= 48483.1  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16  X= 59849.3  AND X>X(10), THUS, E=1.


THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL. = 6            TARGET DIAM. = .03937 INCHES

SIZE CATE.     DROP DIAM.     PROB. OF KILL
  I              R3(I)           P(I)

 1              32.7191        .0340855
 2              78.6843        .173369
 3              145.624        2.64046
 4              235.088        2.45257
 5              325.219        1.43576
 6              416.728        .622441
 7              509.34         .186524
 8              615.165        .0649956
 9              740.186        9.59835E-03
 10             861.789        0
 11             1014.92        0
 12             1198.39        0
 13             1386.02        0
 14             1577.41        0
 15             1734.71        0
 16             1927.36        0

TOTAL PROB. OF KILL = 7.6198
THE VALUES OF  A,  B,  C  &  F  ARE: 0  .5556  0  1


THE MINIMUM LETHAL DOSE DIAM. IS 134.5

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP.
?0
```

```
TYPE  1  IF WANT LINES 4684-4687 PRINTED; ELSE TYPE 0.
?0


TYPE MINIMUM LETHAL DOSE, L1; IF NO MIN. L.D., TYPE 0.
?257.2


TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0.
?0

TYPE:  NO. OF SIZE CLASSES, S3.
?16

TYPE PHOTO-REDUCTION FACTOR, F.
?1

TYPE THE MAGNIFICATION FACTORS A, B & C.
?0,  ..5556,   0
```

SIZE CATE. I	% DROPS P7(I)	STAIN DIAM. D3(I)
1	23.6235	58.8897
2	8.13623	141.62
3	24.3105	262.102
4	22.5832	423.125
5	13.2202	585.348
6	5.73166	750.051
7	1.71753	916.738
8	.598665	1107.21
9	.0785015	1332.23
10	0	1551.1
11	0	1826.7
12	0	2156.93
13	0	2494.63
14	0	2839.11
15	0	3122.24
16	0	3468.97

THE ABOVE RESULTS ARE USE IN FIG. 3

SIZE CATE. I	MASS M5(I)	% MASS 100*M4(I)
1	.0108349	.0502963
2	.0519093	.240966
3	.983294	4.5645
4	3.84254	17.8373
5	5.95549	27.6457
6	5.43205	25.2159
7	2.97211	13.7967
8	1.82459	8.46985
9	.469381	2.17889
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0

THE ABOVE RESULTS ARE USED IN FIG. 4.

TYPE: AIR DEN., AIR VISC., DROP DEN.
?.07421, 12.43E-06, 62.428

TYPE: TAR. DIAM. (INCHES), AIR VEL., NO. OF GAL./ACRE.
?.11811, 1, 1

FOR SIZE CLASS NO. 8 X= 338.724 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 9 X= 490.393 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 10 X= 664.759 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 11 X= 921.98 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 12 X= 1285.46 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13 X= 1719.49 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14 X= 2227.16 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15 X= 2693.51 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16 X= 3324.96 AND X>X(10), THUS, E=1.

```
THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL. = 1               TARGET DIAM. = .11811 INCHES

SIZE CATE.     DROP DIAM.      PROB. OF KILL
  I              R3(I)            P(I)

 1               32.7191        1.94983E-03
 2               78.6843        .020223
 3               145.624        .444219
 4               235.088        1.80229
 5               325.219        1.40507
 6               416.728        .613533
 7               509.34         .18482
 8               615.165        .0649956
 9               740.186        9.59835E-03
 10              861.789        0
 11              1014.92        0
 12              1198.39        0
 13              1386.02        0
 14              1577.41        0
 15              1734.71        0
 16              1927.36        0

TOTAL PROB. OF KILL = 4.5467
THE VALUES OF  A,  B,  C  &  F  ARE: 0  .5556  0  1


THE MINIMUM LETHAL DOSE DIAM. IS 257.2

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP.
?1
```

```
TYPE: TAR. DIAM. (INCHES), AIR VEL., NO. OF GAL./ACRE
?.11811,   6,   1


FOR SIZE CLASS NO. 5  X= 568.023  AND X>X(10), THUS, E=1
FOR SIZE CLASS NO. 6  X= 912.651  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 7  X= 1393.25  AND X>X(10), THUS, E=1
FOR SIZE CLASS NO. 8  X= 2032.34  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 9  X= 2942.36  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 10  X= 3988.55  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 11  X= 5531.88  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 12  X= 7712.76  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13  X= 10316.9  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14  X= 13362.9  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15  X= 16161.1  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16  X= 19949.8  AND X>X(10), THUS, E=1.


THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL. = 6              TARGET DIAM. = .11811 INCHES

SIZE CATE.     DROP DIAM.     PROB. OF KILL
  I              R3(I)            P(I)

 1              32.7191         4.24504E-03
 2              78.6843         .0236812
 3              145.624         .46711
 4              235.088         1.85425
 5              325.219         1.43576
 6              416.728         .622441
 7              509.34          .186524
 8              615.165         .0649956
 9              740.186         9.59835E-03
 10             861.789         0
 11             1014.92         0
 12             1198.39         0
 13             1386.02         0
 14             1577.41         0
 15             1734.71         0
 16             1927.36         0

TOTAL PROB. OF KILL = 4.6686
THE VALUES OF  A,  B,  C  &  F  ARE. 0  .5556  0  1


THE MINIMUM LETHAL DOSE DIAM. IS 257.2

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP.
?0
```

TYPE 1 IF WANT LINES 4684-4687 PRINTED; ELSE TYPE 0.
?0

TYPE MINIMUM LETHAL DOSE, L1, IF NO MIN. L.D., TYPE 0.
?124.8

TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0.
?0

TYPE. NO. OF SIZE CLASSES, S3.
?16

TYPE PHOTO-REDUCTION FACTOR, F.
?1

TYPE THE MAGNIFICATION FACTORS A, B & C.
?0, .5556, 0

SIZE CATE. I	% DROPS P7(I)	STAIN DIAM. D3(I)
1	23.6235	58.8897
2	8.13623	141.62
3	24.3105	262.102
4	22.5832	423.125
5	13.2202	585.348
6	5.73166	750.051
7	1.71753	916.738
8	.598665	1107.21
9	.0785015	1332.23
10	0	1551.1
11	0	1826.7
12	0	2156.93
13	0	2494.63
14	0	2839.11
15	0	3122.24
16	0	3468.97

THE ABOVE RESULTS ARE USE IN FIG. 3

SIZE CATE. I	MASS M5(I)	% MASS 100*M4(I)
1	.0108349	.0502963
2	.0519093	.240966
3	.983294	4.5645
4	3.84254	17.8373
5	5.95549	27.6457
6	5.43205	25.2159
7	2.97211	13.7967
8	1.82459	8.46985
9	.469381	2.17889
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0

THE ABOVE RESULTS ARE USED IN FIG. 4.

```
TYPE: AIR DEN.,  AIR VISC.,  DROP DEN.
? .07421,    12.43E-06,    62.428

TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE.
? .03937,   1,   1


FOR SIZE CLASS NO. 6   X= 466.326   AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 7   X= 696.624   AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 8   X= 1016.17   AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 9   X= 1471.19   AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 10   X= 1994.28   AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 11   X= 2765.94   AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 12   X= 3856.38   AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13   X= 5158.46   AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14   X= 6681.47   AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO 15   X= 8090.52   AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16   X= 9974.89   AND X>X(10), THUS, E=1.
```

```
THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL  = 1                 TARGET DIAM. = .03937 INCHES

SIZE CATE.     DROP DIAM.      PROB  OF KILL
  I              R3(I)            P(I)

 1              32.7191        .0304853
 2              78.6843        .204086
 3              145.624        2.55033
 4              235.088        2.416
 5              325.219        1.42637
 6              416.728        .622441
 7              509.34         .186524
 8              615.165        .0649956
 9              740.186        9.59835E-03
 10             861.789        0
 11             1014.92        0
 12             1198.39        0
 13             1386.02        0
 14             1577.41        0
 15             1734.71        0
 16             1927.36        0

TOTAL PROB. OF KILL = 7.51084
THE VALUES OF  A,  B,  C  &  F  ARE: 0  .5556  0  1


THE MINIMUM LETHAL DOSE DIAM. IS 124.8

TYPE 1 TO RUN PROG. AGAIN, ELSE TYPE 0 TO STOP.
?0


READY
```

```
TYPE  1  IF WANT LINES 4684-4687 PRINTED; ELSE TYPE 0.
?0


TYPE MINIMUM LETHAL DOSE, L1; IF NO MIN. L.D., TYPE 0.
?285.8


TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0.
?0

TYPE  NO. OF SIZE CLASSES, S3.
?16

TYPE PHOTO-REDUCTION FACTOR, F.
?1

TYPE THE MAGNIFICATION FACTORS A, B & C.
?0,   .5556,   0
```

SIZE CATE. I	% DROPS P7(I)	STAIN DIAM. D3(I)
1	23.6235	58.8897
2	8.13623	141.62
3	24.3105	262.102
4	22.5832	423.125
5	13.2202	585.348
6	5.73166	750.051
7	1.71753	916.738
8	.598665	1107.21
9	.0785015	1332.23
10	0	1551.1
11	0	1826.7
12	0	2156.93
13	0	2494.63
14	0	2839.11
15	0	3122.24
16	0	3468.97

THE ABOVE RESULTS ARE USE IN FIG. 3

SIZE CATE I	MASS M5(I)	% MASS 100*M4(I)
1	.0108349	.0502963
2	.0519093	.240966
3	.983294	4.5645
4	3.84254	17.8373
5	5.95549	27.6457
6	5.43205	25.2159
7	2.97211	13.7967
8	1.82459	8.46985
9	.469381	2.17889
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0

THE ABOVE RESULTS ARE USED IN FIG. 4.

```
TYPE: AIR DEN., AIR VISC., DROP DEN.
?.07421, 12.43E-06, 62.428

TYPE: TAR. DIAM. (INCHES), AIR VEL., NO. OF GAL./ACRE.
?.11811, 1, 1


FOR SIZE CLASS NO. 8  X= 338.724  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 9  X= 490.393  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 10  X= 664.759  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 11  X= 921.98  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 12  X= 1285.46  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13  X= 1719.49  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14  X= 2227.16  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15  X= 2693.51  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16  X= 3324.96  AND X>X(10), THUS, E=1
```

THE DATA FOR FIGURE 6 OR 7 APPEARS BELOW.

WIND VEL. = 1   TARGET DIAM = 11811 INCHES

SIZE CATE I	DROP DIAM R3(I)	PROB. OF KILL P(I)
1	32.7191	1.42110E-03
2	78.6843	.0147392
3	145.624	.32376
4	235.088	1.31356
5	325.219	1.40507
6	416.728	.613533
7	509.34	.18482
8	615.165	.0649956
9	740.186	9.59835E-03
10	861.789	0
11	1014.92	0
12	1198.39	0
13	1386.02	0
14	1577.41	0
15	1734.71	0
16	1927.36	0

TOTAL PROB. OF KILL = 3.9315
THE VALUES OF A, B, C & F ARE: 0 .5556 0 1

THE MINIMUM LETHAL DOSE DIAM. IS L285.8

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP.
?0

READY

```
TYPE  1  IF WANT LINES 4684-4687 PRINTED, ELSE TYPE 0.
?0


TYPE MINIMUM LETHAL DOSE, L1, IF NO MIN. L.D., TYPE 0.
?134.5


TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT, ELSE TYPE 0.
?1

TYPE:  NO. OF SIZE CLASSES, S3
?16
```

CALCULATIONS BASED UPON CUM. FREQ. VS. DIAM. FORMAT.

SIZE CATE. I	BDY. DIAM. S3(I)	AVE.DIAM. D3(I)	% DROPS P3(I)	% MASS 100*M4(I)
1	21.4	12.3553	19.18	.0197307
2	34.1	27.9911	11.06	.132297
3	61.5	48.45	20.06	1.24436
4	89.4	75.8786	15.02	3.57901
5	116.9	103.455	11.47	6.92712
6	145.5	131.46	7.49001	9.28096
7	173.7	159.807	5.55	12.3543
8	210.1	192.187	5.32	20.5978
9	250.2	230.441	3.23	21.5584
10	284.7	267.635	.900002	9.41041
11	343.4	314.507	.559998	9.50192
12	397.2	370.626	.110001	3.05447
13	458.1	428.011	.0400009	1.71069
14	514.5	486.572	.0100021	.628449
15	554.7	534.726	0	0
16	631.8	593.667	0	0

THE ABOVE RESULTS ARE USED IN FIGS. 3 & 4.

```
TYPE: AIR DEN.,   AIR VISC.,   DROP DEN.
?.07421,    12.43E-06,    62.428

TYPE:  TAR. DIAM. (INCHES),   AIR VEL.,   NO. OF GAL./ACRE.
?.03937,    1,    1


FOR SIZE CLASS NO. 12  X= 368.854  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO  13  X= 491.919  AND X>X(10), THUS, E=1
FOR SIZE CLASS NO  14  X= 615.738  AND X>X(10), THUS, E=1
FOR SIZE CLASS NO. 15  X= 767.796  AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO  16  X= 946.789  AND X>X(10), THUS  E=1.
```

THE DATA FOR FIGURE 6 OR 7 APPEARS BELOW

WIND VEL. = 1 TARGET DIAM. = 03937 INCHES

SIZE CATE. I	DROP DIAM. R(I)	PROB. OF KILL P(I)
1	12.3553	2.33028E-03
2	27.9911	.0565795
3	48.45	.75132
4	75.8786	2.41036
5	103.455	4.79933
6	131.46	6.54652
7	159.807	5.24832
8	192.187	5.07884
9	230.441	3.09864
10	267.635	.866782
11	314.507	.541599
12	370.626	.10718
13	428.011	.0389752
14	486.572	9.74566E-03
15	534.726	0
16	593.667	0

TOTAL PROB. OF KILL = 29.5565
THE VALUES OF A, B, C & F ARE: 0 1 0 1

THE MINIMUM LETHAL DOSE DIAM. IS 134.5

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP.
?0

TYPE 1 IF WANT LINES 4684-4687 PRINTED; ELSE TYPE 0.
?0

TYPE MINIMUM LETHAL DOSE, L1; IF NO MIN. L.D., TYPE 0.
?124.8

TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0.
?1

TYPE: NO. OF SIZE CLASSES, S3.
?16

CALCULATIONS BASED UPON CUM. FREQ. VS. DIAM. FORMAT.

SIZE CATE. I	BDY. DIAM. S3(I)	AVE. DIAM. D3(I)	% DROPS P3(I)	% MASS 100*M4(I)
1	21.4	12.3553	19.18	.0197307
2	34.1	27.9511	11.06	.132297
3	61.5	48.45	20.06	1.24436
4	89.4	75.8786	15.02	3.57901
5	116.9	103.455	11.47	6.92712
6	145.5	131.46	7.49001	9.28096
7	173.7	159.807	5.55	12.3543
8	210.1	192.187	5.32	20.5978
9	250.2	230.441	3.23	21.5584
10	284.7	267.635	.900002	9.41041
11	341.4	314.507	.559998	9.50192
12	397.2	370.626	.110001	3.05447
13	458.1	428.011	.0400009	1.71069
14	514.5	486.572	.0100021	.628449
15	554.7	534.726	0	0
16	631.8	593.667	0	0

THE ABOVE RESULTS ARE USED IN FIGS. 3 & 4.

TYPE: AIR DEN., AIR VISC., DROP DEN.
?.07421, 12.43E-06, 62.428

TYPE: TAR. DIAM. (INCHES), AIR VEL., NO. OF GAL./ACRE.
?.03937, 1, 1

Run 19.

FOR SIZE CLASS NO. 12 X= 366.854 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 13 X= 491.919 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 14 X= 625.738 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 15 X= 767.796 AND X>X(10), THUS, E=1.
FOR SIZE CLASS NO. 16 X= 946.389 AND X>X(10), THUS, E=1.

THE DATA FOR FIGURE 6 OR 7 APPEARS BELOW.

WIND VEL. = 1 TARGET DIAM. = .03937 INCHES

SIZE CATE. I	DROP DIAM. R3(I)	PROB. OF KILL P(I)
1	12.3553	2.91697E-03
2	27.9911	.0708243
3	48.45	.940477
4	75.8786	3.0172
5	103.455	6.00764
6	131.46	7.01134
7	159.807	5.24832
8	192.187	5.07884
9	230.441	3.09864
10	267.635	.866782
11	314.507	.541599
12	370.626	.10718
13	428.011	.0389752
14	486.572	9.74566E-03
15	534.726	0
16	593.667	0

TOTAL PROB. OF KILL = 32.0405
THE VALUES OF A, B, C & F ARE: 0 1 0 1

THE MINIMUM LETHAL DOSE DIAM. IS 124.8

TYPE 1 TO RUN PROG. AGAIN, ELSE TYPE 0 TO STOP
?0

Run 19 (continued)

```
TYPE  1  IF WANT LINES 4684-4687 PRINTED; ELSE TYPE 0.
?0


TYPE MINIMUM LETHAL DOSE, L1, IF NO MIN. L.D., TYPE 0.
?257.2


TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0.
?1

TYPE:  NO. OF SIZE CLASSES, S3.
?16
```

CALCULATIONS BASED UPON CUM. FREQ. VS. DIAM. FORMAT.

SIZE CATE. I	BDY. DIAM. S3(I)	AVE. DIAM. D3(I)	% DROPS P3(I)	% MASS 100*M4(I)
1	21.4	12.3553	19.18	.0197307
2	34.1	27 9911	11.06	.132297
3	61.5	43 45	20.06	1.24436
4	89.4	75.8786	15.02	3.57901
5	116.9	103.455	11.47	6.92712
6	145.5	131.46	7.49001	9.28096
7	173.7	159.807	5.55	12.3543
8	210.1	192.187	5.32	20.5978
9	250.2	230.441	3.23	21.5584
10	284.7	267.635	.900002	9.41041
11	343.4	314.507	.559998	9.50192
12	397.2	370.626	.110001	3.05447
13	458.1	428.011	.0400009	1.71069
14	514.5	486.572	.0100021	.628449
15	554.7	534.726	0	0
16	631.8	593.667	0	0

THE ABOVE RESULTS ARE USED IN FIGS. 3 & 4.

```
TYPE AIR DEN.,  AIR VISC.,  DROP DEN.
?.07421,   12.43E-06,   62.428

TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE.
?.11811,   1,  1
```

```
THE DATA FOR FIGURE  6  OR  7  APPEARS BELOW.

WIND VEL. = 1                TARGET DIAM. = .11811 INCHES

SIZE CATE.     DROP DIAM.      PROB. OF KILL
  I              R3(I)            P(I)

 1               12.3553          0
 2               27.9911          4.03408E-03
 3               48.45            .0760617
 4               75.8786          .295487
 5               103.455          .63953
 6               131.46           .89389
 7               159.807          1.21206
 8               192.187          2.05305
 9               230.441          2.17601
 10              267.635          .8496
 11              314.507           533058
 12              370.626          .105322
 13              428.011          .0384443
 14              486.572          9.64513E-03
 15              534.726          0
 16              593.667          0

TOTAL PROB. OF KILL = 8.88619
THE VALUES OF  A,  B,  C  &  F  ARE: 0  1  0  1


THE MINIMUM LETHAL DOSE DIAM. IS 257.2

TYPE 1 TO RUN PROG. AGAIN, ELSE TYPE 0 TO STOP.
?0
```

Run 20 (continued)

```
TYPE  1  IF WANT LINES 4684-4697 PRINTED, ELSE TYPE 0.
?0

TYPE MINIMUM LETHAL DOSE, L1; IF NO MIN. L.D., TYPE 0.
?285.8

TYPE 1 IF CUM. FREQ. VS. DIAM. INPUT FORMAT; ELSE TYPE 0.
?1

TYPE:  NO. OF SIZE CLASSES, S3.
?16
```

CALCULATIONS BASED UPON CUM. FREQ. VS. DIAM. FORMAT.

SIZE CATE. I	BDY. DIAM. S3(I)	AVE. DIAM. D3(I)	% DROPS P3(I)	% MASS 100*M4(I)
1	21.4	12.3553	19.18	.0197307
2	34.1	27.3911	11.06	.132297
3	61.5	45.45	20.06	1.24436
4	89.4	75.8786	15.02	3.57901
5	116.9	103.455	11.47	6.92712
6	145.5	131.46	7.49001	9.28096
7	173.7	159.807	5.55	12.3543
8	210.1	192.187	5.32	20.5978
9	250.2	230.441	3.23	21.5584
10	284.7	267.635	.900002	9.41041
11	343.4	314.507	.559998	9.50192
12	397.2	370.626	.110001	3.05447
13	458.1	428.011	.0400009	1.71069
14	514.5	486.572	.0100021	.628449
15	554.7	534.726	0	0
16	631.8	593.667	0	0

THE ABOVE RESULTS ARE USED IN FIGS 3 & 4.

```
TYPE: AIR DEN.,  AIR VISC.,  DROP DEN.
?.07421,    12.43E-06,    62.428

TYPE:  TAR. DIAM. (INCHES),  AIR VEL.,  NO. OF GAL./ACRE.
?.11811,    1,    1
```

THE DATA FOR FIGURE 6 OR 7 APPEARS BELOW.

WIND VEL. = 1 TARGET DIAM. = .11811 INCHES

SIZE CATE. I	DROP DIAM. R3(I)	PROB. OF KILL P(I)
1	12.3553	0
2	27.9911	2.94016E-03
3	48.45	.055436
4	75.8786	.21536
5	103.455	.466109
6	131.46	.651494
7	159.807	.883387
8	192.187	1.49632
9	230.441	1.58594
10	267.635	.697683
11	314.507	.533058
12	370.626	.105322
13	428.011	.0384443
14	486.572	9.64513E-03
15	534.726	0
16	593.667	0

TOTAL PROB. OF KILL = 6.74114
THE VALUES OF A, B, C & F ARE: 0 1 0 1

THE MINIMUM LETHAL DOSE DIAM. IS 285.8

TYPE 1 TO RUN PROG. AGAIN; ELSE TYPE 0 TO STOP
?0